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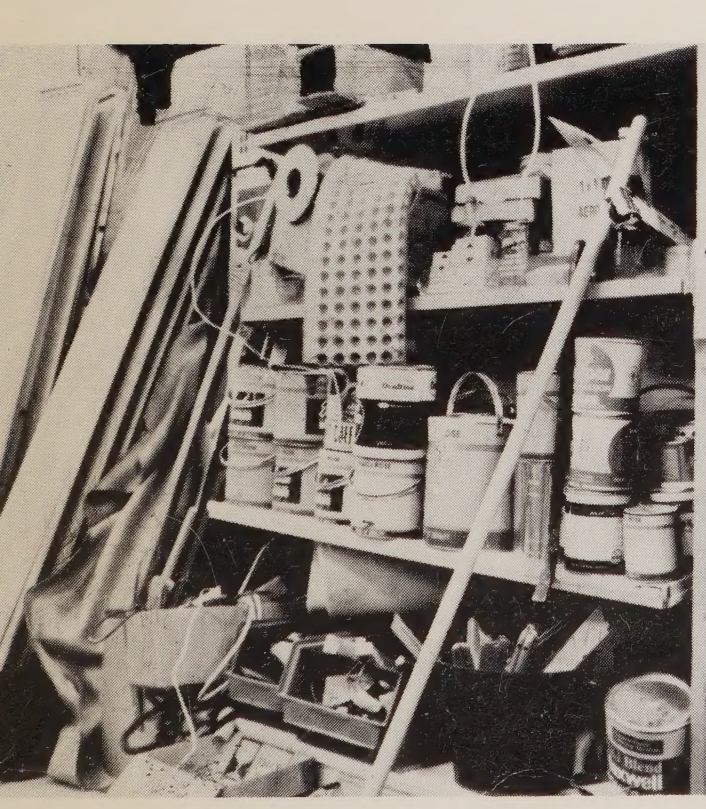
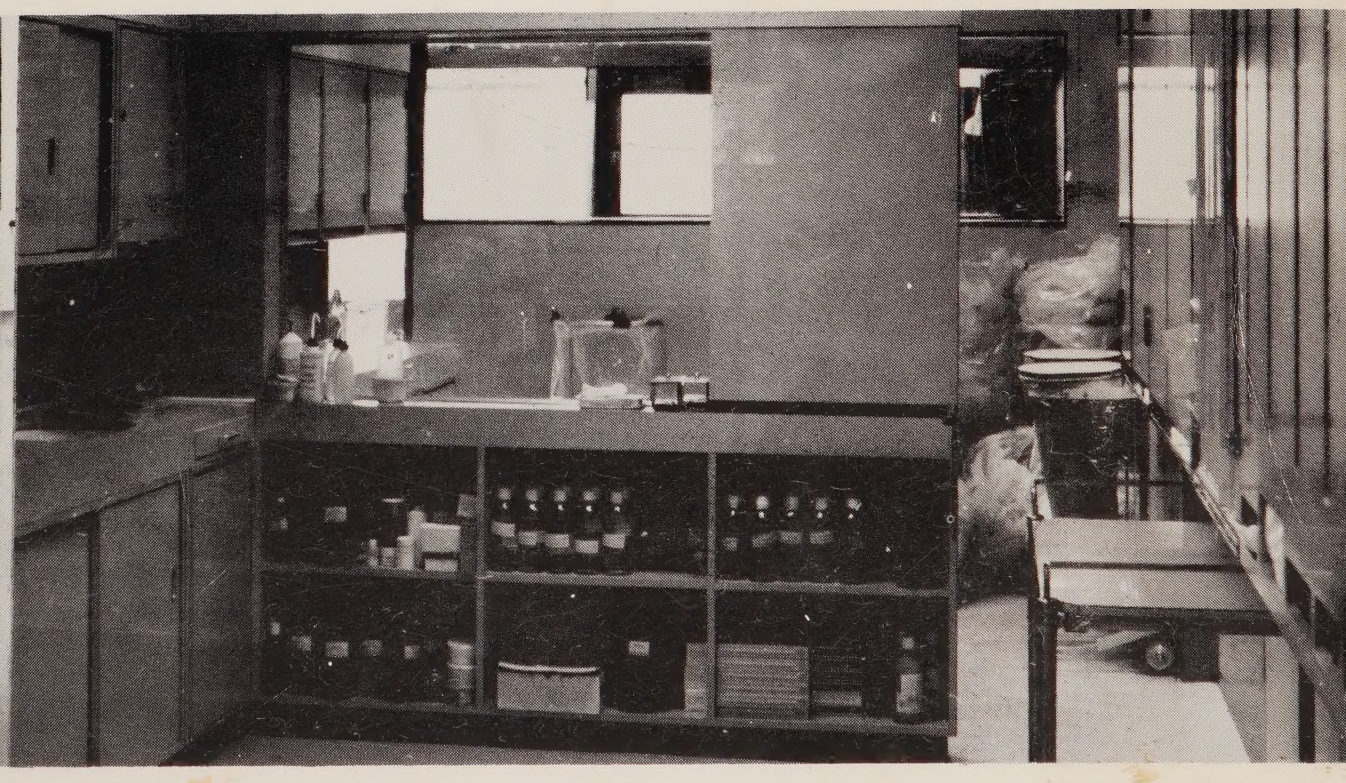
Storage at point-of-use





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February 1973

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PREFACE

This report is intended as a book of reference for all those who are new to the problems of storage at point-of-use.

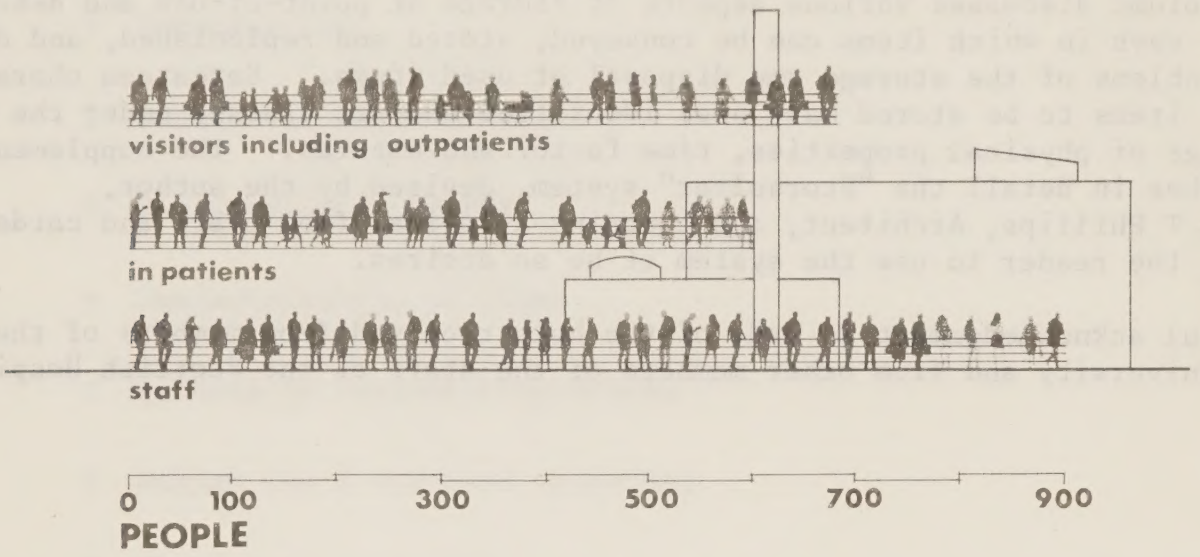
There are considerable advantages in using a systematic approach to solving complicated problems that involve large numbers of items and the services of many experts in different fields, for example, pharmacists, supplies officers, medical and nursing staff, architects, structural engineers, mechanical engineers. When people from these different disciplines meet to discuss a common problem such as storage, a good deal of time and effort is spent at the beginning of these sessions on discussing ways of finding a common basis for decision making which is acceptable and understandable to all the participants. One of the purposes of this report which has a separate supplement, is to provide the hospital planner and his architect with a system for collecting this information and translating it into the physical and environmental requirements for a storage system.

This volume discusses various aspects of storage at point-of-use and describes some of the ways in which items can be conveyed, stored and replenished, and discusses the problems of the storage and disposal of used items. Seventeen characteristics of the items to be stored have been identified and are classed under the main headings of physical properties, time factor and hazards. The supplement describes in detail the "Storsolver" system, devised by the author, Miss E T Phillips, Architect, and contains a logical flow chart and cards which enable the reader to use the system if he so desires.

Grateful acknowledgement is made of the help received from members of the Heriot-Watt University and from other members of the staff of the Scottish Hospital Centre.

PART 1 INTRODUCTION

1.1 Provisioning has been defined as the estimation of the quantities of goods to be acquired to be put into stores, the time-table of doing it and the estimation of consumption rates.[78] If in this context one considers the provisioning required to run even a 600-bed district general hospital it soon becomes evident that it is a problem worth tackling in a logical way. The proportion of patients to staff in this type of hospital is approximately one to two, therefore a 600-bed district general hospital (DGH) will have approximately 1200 staff, giving a total of 1800 people. Thus the provisioning requirements are equivalent to that of a small town with all its residents; also, it has to be remembered that this is no ordinary town, but one which has a continuous work commitment throughout every 24 hours and attracts many visitors at certain times of the day. Considering the basic living pattern, apart from treatment, all the patients and some of the staff require all the resources necessary to eat and sleep, and the whole complement of 1800 plus some of the visitors will require sustenance at some time during the day.



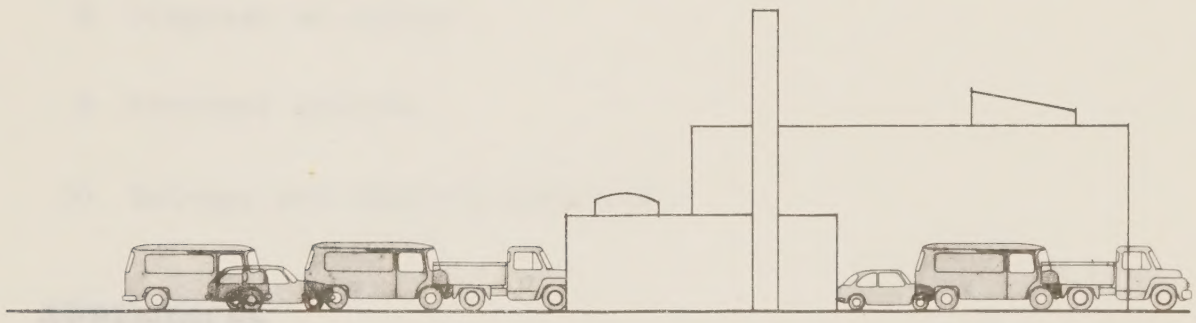


DIAGRAM 1.1 People within or visiting a hospital in any one day, together with the provisioning requirements

1.2 Meister[51] suggests that the average weight of goods handled in a 100-bed teaching hospital is 50-60 kg per patient per day. His figure includes food, laundry, medical supplies and documents. This suggests that a 600-bed DGH may well handle a total of 3000 kg (3 tons) per day. The waste from a DGH of the same size has been estimated at approx 1200 kg (1.2 tons) per day.

1.3 The undernoted list of main categories of staff[83] employed in all types of hospital may help to remind the reader of the variety of activities which may be carried out within a hospital and its environs. A DGH would of course produce a slight reduction in this number of categories, for example, mental and mental deficiency nursing staff together with all the sub-categories would not be included, nor for instance would certain sub-categories of para-medical staff, farm managers and farm workers.

Medical and dental staff
Nursing staff
Maternity nursing staff
Mental nursing staff
Mental deficiency nursing staff
Medical auxiliaries

Dispensary
Scientific staff
Hospital operative staff and special grades
Domestic and ancillary staff
Craftsmen and tradesmen
Clerical staff
All other staff not included in the above list

1.4 Details of the individual grades within the main categories are listed in Appendix II. From this list some general idea may be obtained of the stores required at point-of-use. Whether it is a nurse making patients comfortable by giving them bedpans and clean sheets, a surgeon carrying out an operation, a technician mixing solutions in his laboratory, or a plumber mending a dripping tap, they all need provisioning to carry out their work and they all want equipment and materials to hand. The decision to store any item at point-of-use should cause immediate warning signals in the mind of the hospital planner; those warning signals should form themselves into algorithms for describing the various ways that the supply, storage, use and disposal of that item may be dealt with.

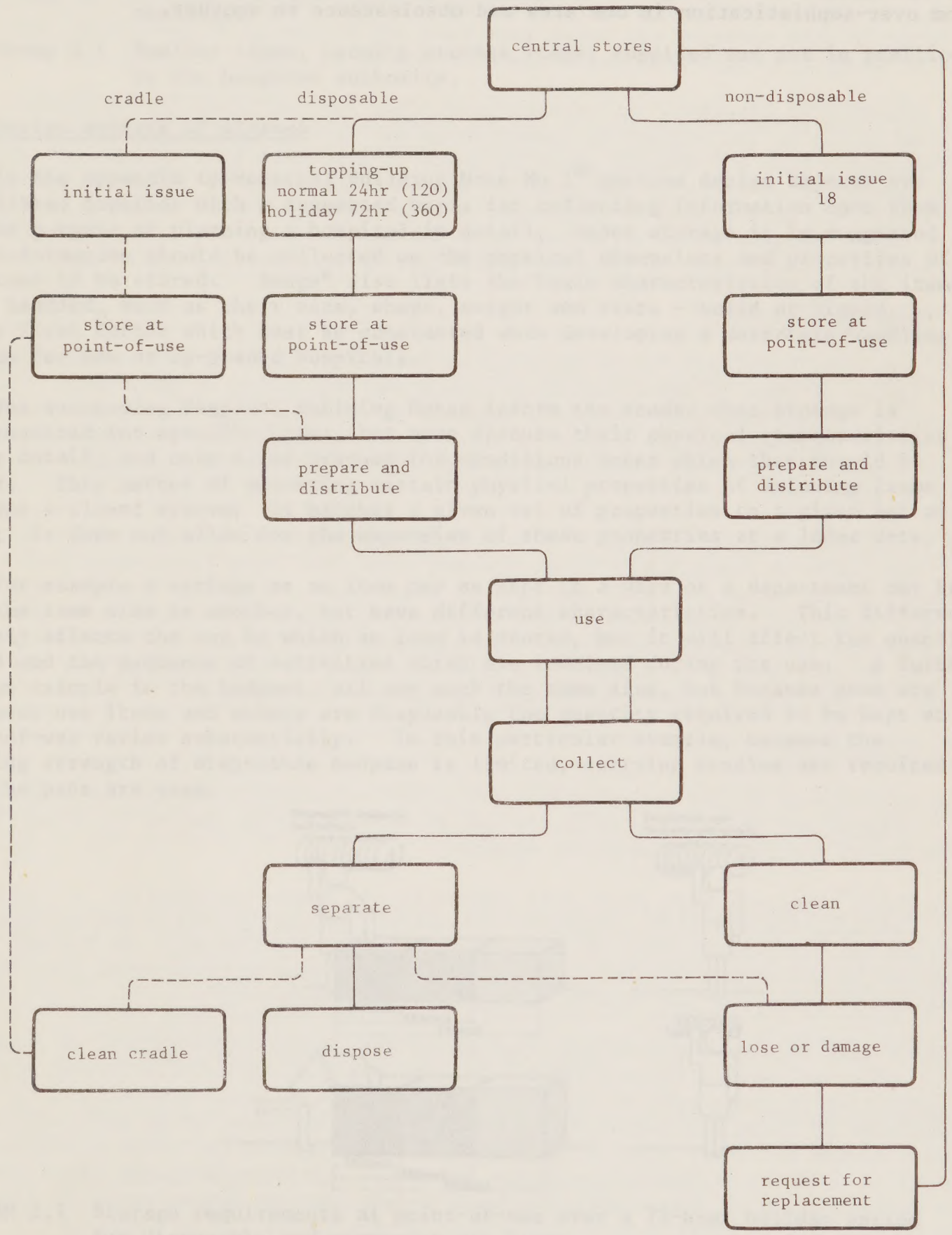


DIAGRAM 1.2 Differential requirements for disposable and non-disposable bedpans in an acute orthopaedic ward

1.5 Hospital Planning Note 1 (paragraph 41)[84] states that ward units are the principal users of hospital supplies and clearly the principles of supply have to be determined before design can proceed. Equally, methods of disposal affect ward design. These need consideration of a fundamental kind.

1.6 Bangs[8] notes that whether developing a materials handling program for a new hospital or planning for the rehabilitation of an existing facility there are certain factors that must be considered that will influence every facet of the program. This statement emphasises the fact that consideration has to be given to systems rather than individual activities; therefore anything that is part of the system must be matched to the whole system. In this context storage lies between supply and disposal. There is no point in making *ad hoc* decisions for specialist storage or disposal units; they cannot be guaranteed to fit the system. For example, the *ad hoc* decision to provide thin gauge for all waste bags within a system which uses chutes to dispose of waste from a 5 or 6-storey building will inevitably result in a high proportion of burst bags at the chute exit, and give the hospital the problem of clearing up the mess at the exit and in the actual chute lining itself. Likewise there is little point in spending money on one part of the system and not on another; this is more likely to lead to blocks in the system from over-sophistication in one area and obsolescence in another.

PART 2 STORAGE AT POINT-OF-USE

Published lists of storage items

2.1 The Hospital Equipment Notes[27] list items to be provided in the hospital necessary for its functioning, these include both non-technical and technical equipment: they do not include short-term consumables such as fuel, provisions, stationery, drugs and dressings. The items listed are classified into four main groups depending on how they are to be supplied and fixed.

Group 1[31]: Items usually supplied and fixed by the contractor for the works.

Group 2 : Items having a permanent or semi-permanent location and having a significant effect on space and/or structural requirements, ie those supplied by the hospital authorities and fixed by the contractor for works.

Group 3 : Items having permanent or semi-permanent location and having a significant effect on space and/or structural requirements, ie those supplied by the hospital authority and put in position by them or on their instructions outside the general construction contract.

Group 4 : Smaller items, usually storage items, supplied and put in position by the hospital authority.

Design aspects of storage

2.2 In the appendix to Hospital Building Note No 1[56] various design aspects are listed together with a suggested basis for collecting information upon them for the purpose of planning a hospital in detail; under storage it is suggested that information should be collected on the physical dimensions and properties of all items to be stored. Bangs[8] also lists the basic characteristics of the items to be handled, such as their size, shape, weight and state - solid or liquid..., as the first factor which must be considered when developing a materials handling program for new or up-graded hospitals.

2.3 The succeeding Hospital Building Notes inform the reader that storage is required for specific items, but none discuss their physical characteristics in any detail, and only a few discuss the conditions under which they should be stored. This method of measuring certain physical properties of existing items produces a closed system; it matches a given set of properties to a given set of items; it does not allow for the expansion of these properties at a later date.

2.4 For example a syringe as an item *per se* kept in a ward or a department may be the same size as another, but have different characteristics. This difference not only affects the way in which an item is stored, but it will affect the quantity stored and the sequence of activities which are involved during its use. A further obvious example is the bedpan; all are much the same size, but because some are permanent use items and others are disposable the quantity required to be kept at point-of-use varies substantially. In this particular example, because the crushing strength of disposable bedpans is limited, carrying cradles are required when the pans are used.

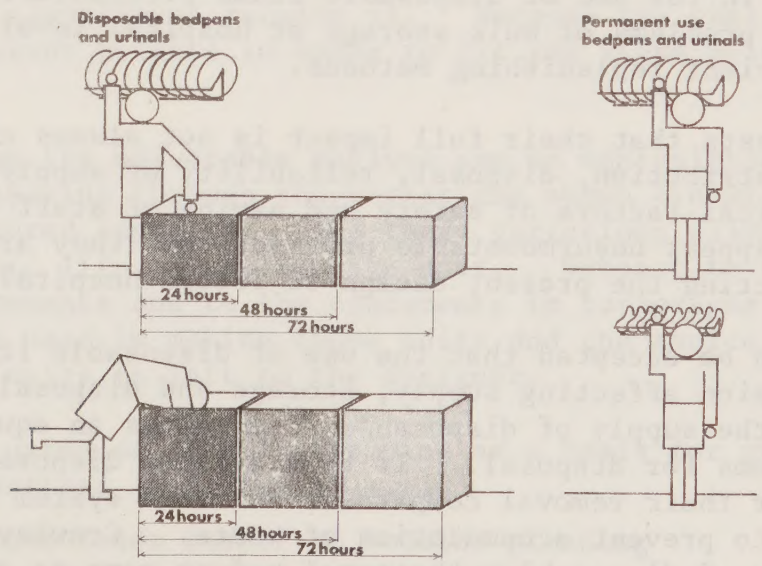


DIAGRAM 2.1 Storage requirements at point-of-use over a 72-hour holiday period for disposable and permanent use items

2.5 Wherever possible, the hospital planning team must look ahead and consider likely changes and trends in medical and nursing care, and provide for these future trends in the brief which is presented to the designer as his working tool. An example which supports this view relates to the present day care of geriatrics where, with a policy of early ambulation and occupational therapy, storage areas within older geriatric ward units are now overflowing into the corridors and toilet areas with patient hoists, wheelchairs, walking aids and occupational therapy apparatus. These hospitals were designed when the majority of patients were confined to bed, and those who did get up sat by their bedside even for meals.

Large items

2.6 Different categories of items for storage at point-of-use give rise to specific problems, not least in this respect are the large items which are used at infrequent intervals or which are shared by several departments. Types of item in this category are balkan beams, cot sides, and wheelchairs: such items are usually bulky and often difficult to store, especially if they are attachments for beds; these are often odd shapes and rarely stand up on their own. Frequently they have no specific storage space allocated and are usually to be found in corridors or filling up much needed space in the treatment rooms, sluice rooms etc in ward areas. If items in this category are being used with any frequency at department level they must be properly stored and have a space allocated to them.

2.7 Specific requirements for storing particular section items can be deduced by referring to the Storsolver system described in the supplement to this report, but basically they all require space in which to manoeuvre them because of their size, and rails or hooks or some similar devices upon which to retain items that are accessories to main pieces of equipment, and are not capable of standing upright on their own. Because these items are large and often cumbersome it is important that the designer should know of their existence before he plans his building.

Temporary storage

2.8 A further consideration to be given to stores at point-of-use is the temporary nature of some of these positions within the department or ward unit. Most laboratory procedures will contain a sequence of activities which involve temporary storage of specimens before a test is carried out. Similarly, consumables are often stored in different places before and after they have been prepared for use even at ward level.

2.9 Hospital Planning Note No 1[84] states that the temporary storage points in the ward must be conveniently close to each other for items frequently used together or in connection with one type of procedure. Whatever the type and size of an item it must be remembered that by the time stores are delivered to their point-of-use the requirement is for live storage, that is, for materials and equipment to be continually in demand; it must therefore be easily accessible and not hidden at the back of cupboards or high up against the ceiling.

Disposables

2.10 An increase in the use of disposable items particularly in nursing supplies has created new problems of bulk storage at hospital level and at the point-of-use in spite of efficient replenishing methods.

2.11 White[99] suggests that their full impact is not always considered; it includes storage, distribution, disposal, reliability of supply, costs and savings as well as the clinical factors of safety and saving of staff time. He states "the problems do not appear unsurmountable provided that they are foreseen: they should, however, be affecting the present design of future hospitals".

2.12 It must then be accepted that the use of disposable items is part of a general policy decision affecting supply, storage and disposal at all levels, and that acceleration in the supply of disposable items gives an equal acceleration in the quantities of items for disposal. If they are not disposed of at point-of-use, then a system for their removal comparable with the system for their supply is needed in order to prevent accumulation of waste. Crawley Hospital found that with the extensive use of disposables the total refuse came to approximately 2.3 kg (5lb) per patient per day.[35]

2.13 In an article on plastic waste and its disposal[17] the term "disposable" is ascribed to those articles of plastic which can be produced quite cheaply in

large numbers, used once and then discarded. The article continues "disposable in this sense is a word which has acquired an additional subtle meaning. A disposable article is one whose disposal is someone else's problem and since one of the desirable properties of plastics is their long-term stability, disposable is a blatant misnomer. These items will not disappear of their own accord and because of their inert characteristics, which are so attractive in use, their treatment as waste creates problems both in terms of cost and technique".

Planned maintenance and cleaning

2.14 In whatever way items are to be stored at point-of-use it is necessary to have a well organised planned maintenance and cleaning programme. Hospitals are not alone in paying greater attention to the cleaning of large storage units than to the smaller items. Paper towel dispensers are an example of the latter, they are frequently replenished on a topping-up system into a permanent dispenser. Because of their static nature and the replenishing system, these dispensers are rarely if ever empty and thus infrequently cleaned inside. Also, the plastic materials from which many of them are made are prone to collect dust. It is therefore recommended that all such storage holders are emptied and thoroughly cleaned at regular intervals as part of a planned cleaning programme.

Storage units

2.15 The design of storage units over the past years has been the subject of considerable time and effort within the hospitals themselves as well as by outside bodies with interests in specific aspects of storage problems. In spite of all this effort many storage units specifically designed to take a particular consumable or item of equipment have not had the chance to be used to the end of their economic life.

2.16 There are two main reasons for this, firstly, because an item is no longer available, or it has been superseded and, secondly, because that particular item around which the storage item has been designed has since been packaged in a different way. These reasons both imply that flexibility or adaptability is the critical design factor to be considered in the physical and environmental design of storage units. Since new items and their packaging cannot be expected to fit existing bespoke storage units it follows that the units must adapt to the new items. Items change not only in shape and size, but also in quantity; this is a difficult problem to solve, especially when designing temporary storage and reserve storage for holidays and emergencies. The implication is that storage units must adapt to increasing and decreasing quantities of items and that this adaptability is directly related to the services available for replenishing stock at point-of-use.

2.17 The problem of having to discard bespoke storage units because the item is no longer available or superseded can be solved by reducing all storage units to a simple system of adjustable height shelving. The next chapter describes in outline, and the supplement to this report describes in full a system of evaluating the requirement for particular items or groups of items to be stored. This system develops the idea of adjustable shelving and sets out the various requirements for specific characteristics of any item which may be used in a hospital. The shelves should be adjustable in height at least every 30mm ($1\frac{1}{4}$"), and should only be enclosed if security or cleanliness require it. Because the shelves are adjustable they can be set at different heights in order to fit the items being stored at any one time.

2.18 This recommendation for adjustable shelves can be manipulated from the simple version of open shelving through the variations shown (in Diagram 2.2 overleaf) to a fully secured cupboard. All these variations allow for full flexibility during the economic life of the storage unit. Subject to complying with certain statutory requirements and to the statements in paragraphs 2.20 and 2.21 the type of construction used in making these units and the choice between free-standing and well-fixed units is left to the designer.

2.19 The advantages of using adjustable shelving as a basis for storage at point-of-use can be summarised as follows:-

1 a standard system lends itself to modular planning
2 to prevent the obsolescence of bespoke units
3 to adapt to the variations in manufacturers pack sizes
4 to provide for the variation in the quantity of storage required

5 to provide for the removal of shelves when it may be necessary to use trolleys or other equipment for the converse situation
6 for ease of moving units from one area to another for re-use
7 to enable any unit damaged to be quickly replaced from stock
8 units can be easily erected by works staff
9 units can be easily adjusted by department staff or porters
10 for the ease of planned maintenance
11 worn units could be downgraded to 'dead' stores and works departments
12 reserve stock of units can be held in a 'knock-down' condition
13 to enable the hospital to buy in bulk
14 units will be manufacturers' stock items always available at competitive prices

DIAGRAM 2.2 Variations on adjustable shelving

2.20 With the advent of system building components it becomes more and more difficult for the hospital joiner just to 'knock up' a few shelves. The partition walls are probably hollow and are not what is termed 'load bearing'; this means that they are not expected to carry extra weights put upon them. Wherever non-load bearing partitions are used, loaded shelves supported by brackets, or cantilever shelving which relies on being tied back to the wall for support, must be fitted within special areas which are designed to take loads, or at points where back plates may be provided to spread the load. Unless the designer and contractor are absolutely certain of the position of the strengthened points in the walls it is recommended that free-standing units are used, and held lightly back to the wall or wedged up to the ceiling if there is any likelihood of the unit turning over. Also if any unit requires to be fixed to the structure for security reasons, care should be taken over the fixings used.

2.21 Similarly a discipline is required when heavy loads are to be placed either on shelving or directly on the floor, shelving transmits weight through point loads which can easily be in excess of the specified floor loading (usually expressed as a uniformly distributed load of a stated number of kgs/m^2 (lbs/sq ft). It is suggested that heavy loads including heavy mobile loads are confined to certain areas where the floor has been strengthened. Notices and coloured floor markings may work under special circumstances, but they should not be relied upon as a general measure.

PART 3 THE STORSOLVER SYSTEM

3.1 The Storsolver system has been devised by the author in order to provide a systematic approach to solving storage problems at point-of-use in hospitals. The objective is to provide a basic frame-work for the input of knowledge which will result in a comprehensive set of instructions for the designer.

3.2 The system of decision making proposed is intended to help planning teams to understand and solve storage problems rapidly and efficiently and is operated in these stages.

1 The *scope* of the problem is established. All the items to be used in a department or ward are listed. This can either be done by using existing inventories, or by using lists given in government publications:[27] these existing or published lists are used as a guide, and must be revised to cover current trends and standards of hospital care.

2 The problem is *analysed*. Examples are selected from each type of equipment and consumables held at point-of-use and studied in turn. Each item will have certain "characteristics" (weight, frequency of use, danger, etc) that will determine the kind of storage it needs. The Storsolver system described in detail in the supplement to this report includes a catalogue of characteristics from which the planning team selects those applicable to the item being studied.

3 The *solution* to the problem is decided. Each characteristic in the system carries one or more "answers" to the problem, covering each physical and environmental storage requirement. The "answers" added together give a specification for the kind of storage needed for the item being studied. This is then multiplied by the quantity of that item to give the amount of storage needed. This amount of space is directly related to the frequency of replenishing and it *must* be sufficient to cover the longest time between replenishing such as Bank Holiday weekends.

3.3 A sample study of requirements for sterile packs serving a hospital group of 1200 teaching beds indicated that over 80% of these items had similar characteristics and therefore required a similar storage system.

3.4 The advantages of the Storsolver system are that:-

1 all members of the planning team are working to the same rules

2 each departmental representative can operate the system for his own stores, and yet produce a result that can be co-ordinated into a whole-hospital storage brief

3 all members of the planning team have to think clearly about their storage problems before making decisions

4 the hospital designers and engineers are given a complete and accurate brief on storage requirements *before* designing the detailed building layout

5 existing storage systems and proposed storage systems can be evaluated by checking them against the "answers" specification for the items to be stored

6 in the course of time, a data bank can be built up that will supply information on storage problems to any planning team.

3.5 The Storsolver system can be operated in two ways according to the size and complexity of the project. For small projects a manual method using a special chart or cards of characteristics and answers is recommended; it is very simple and does not involve the use of computer time. Each member of the planning team can work on it independently using his or her own chart or cards; this means that discussions between members need occupy only the minimum amount of time, that is the amount of time required to co-ordinate their findings. For larger projects where a full-time planning team is employed it is more efficient to operate the system by means of a standard computer dialogue program. Such a program has been designed and is in the course of development into a complete package program: it is briefly described in the supplement.

PART 4 CHARACTERISTICS OF ITEMS

4.1 The characteristics of an item are:-

1 the *physical* properties that it has in itself such as weight and size

2 the *time* factor relating to item; these factors relate to the life span of an actual item and to the urgency or frequency with which it is used

3 the *hazards* which an item can cause, and the *controls* required to keep these physical properties effective or the *controls* required to counteract the hazards.

4.2 The physical properties of an item describe the item itself and the container (if any) necessary for its storage. These properties do not change unless the item itself is processed or packaged in a different way. The characteristics relating to *time* must be related to the *controls* used for its storage and to an even greater extent to the activity for which the item is to be used. The characteristics relating to *hazards* and *controls* must always be related to the conditions in which the item is stored.

4.3 All these characteristics are interrelated, and it is necessary to consider them not as a set of unrelated characteristics, but as a set of characteristics which describe an item in the situation in which it is to be stored at point-of-use for a specific activity or set of activities.

4.4 The way in which one item is stored can affect other items close to it. For example, refrigerators give off heat which may damage adjoining goods; radio-isotopes stored too close to photographic film may damage it, whilst food stored close to strong smelling substances will pick up an off-flavour. This factor of the juxtaposition between one storage item and another, or one type of storage unit and another is too often forgotten at point-of-use; it must be considered at the earliest planning stage of the storage system and be used as a design restraint at a later stage. Finally it must be remembered by those putting stores into place. Too often special areas allocated for particular items are not used because the person who actually places the stores on their storage units has not been informed. Good in-service training backed by good labelling systems should help to overcome this problem and so save the waste of good stores.

4.5 The external influences of environment will also have a considerable effect upon the manner in which items are stored. For example certain perishable goods will keep unrefrigerated in a cool atmosphere, but will require refrigeration if they are kept at ward unit level in a temperature of approximately 20°C (68°F).

4.6 For the purpose of describing the properties of items to be found in hospitals, 17 characteristics have been identified: these are listed below under the three main headings given at the beginning of this chapter.

PHYSICAL	1	weight: size ratio
	2	fragility
	3	position held
	4	danger
TIME	5	shelf life
	6	urgency
	7	frequency
HAZARDS AND CONTROLS	8	security
	9	temperature range
	10	light
	11	moisture range
	12	radiation
	13	vibration
	14	noise
	15	effluent
	16	fumes
	17	dust

4.7 In order to discuss the characteristics of items so that they may be used to cover all items in a hospital and also so that they may be understood by anyone using the system, it is essential to express them in defined terms. Failure to do this can easily lead to the misunderstanding of such sub-characteristics as *light* or *heavy*, *hot* or *cold*. Not only will they mean different things to different people, they will also mean different things to one person considering various items under different circumstances.

4.8 The following pages define these characteristics, and their sub-characteristics and discusses some of the problems which may arise when hospital planners, designers and users are considering the handling, transit and storage of items to be used at point-of-use.

1	WEIGHT: SIZE RATIO	a	Heavy: bulky
		b	Heavy: manageable
		c	Heavy: small
		d	Moderate: bulky
		e	Moderate: manageable
		f	Moderate: small
		g	Light: bulky
		h	Light: manageable
		i	Light: small

The weight and size ratios are defined as follows, for weight:

Heavy = over 10 kg (22 lbs)
Moderate = 4 kg to 10 kg (8.8 lbs to 22 lbs)
Light = under 4 kg (8.8 lbs)

and for size:

Bulky = larger than manageable
Manageable = 35 x 25 x 20 cm to 50 x 35 x 35 cm (14 x 10 x 8 ins to 20 x 14 x 14 ins)
Small = smaller than manageable

4.9 In order to have a consistency in the measurement of items, it is suggested that BS 1192[11] is used as a guide. In this standard, the following sequence of measures is given:

1 Length
2 Width
3 Depth* or Height

* it also recommends that depth should not be used as a horizontal measure.

From the illustrations given below, it can be easily seen how much effect an inconsistent sequence of measures could have upon the storage requirements.

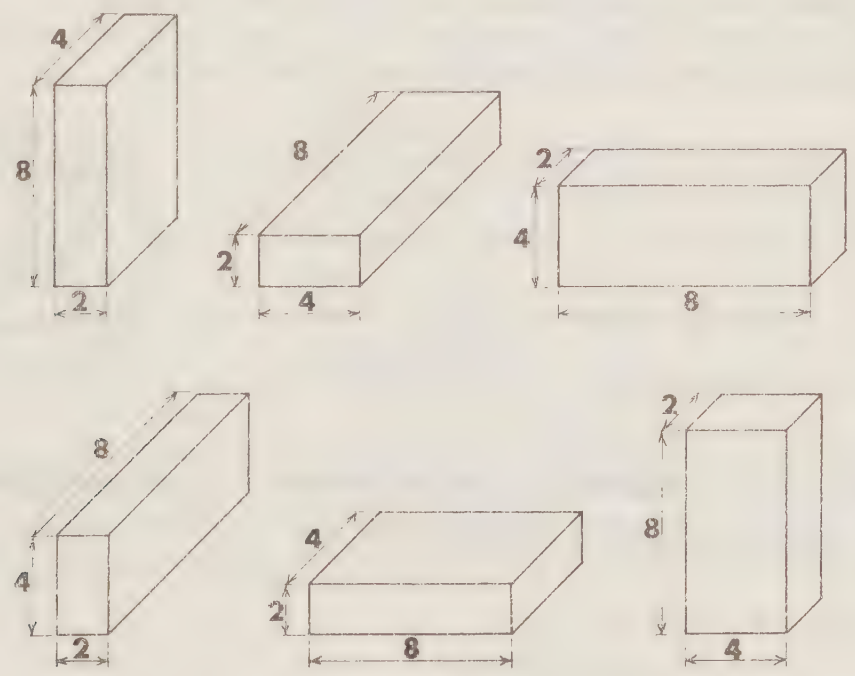


DIAGRAM 4.1 Inconsistent sequential measurements on a three-dimensional object

4.10 The planning of storage areas must be related not only to the *weight* and *size* of an item but also to the numbers of that item to be stored together. Glass slides used by the pathology department are not *heavy* as individual items, but because they are often held in large batches weight is a problem not only from the point of view of the storage unit, but of the floor loading as well. For the benefit of simplicity and conformity any measure which exceeds the dimensions stated in the sub-categories should automatically put that item in the next category. For example lengths of pipes and rolled drawings which are over 500 mm (20") long should be classed as *bulky*. The dimensions given are for overall measures and should include projecting handles etc.

4.11 Although much useful information is available from Hospital Service Design Note 3[26] it does not define what is considered as *light* or *heavy* loads, nor does it define *size*. These characteristics are described here in relation to loads which women can handle, as it is they who will be the limiting factor if they handle the items at any point between transit from central stores to disposal or consumption.

4.12 When measuring an item in order to ascertain its bulk, it must be remembered that this item only has the same bulk if ordered in the same package. Tablets packed as individual units within a bubble foil pack will take up approximately twice the bulk of tablets contained in bottles of a hundred. Similarly individually packed syringes in sealed plastic packs contain a high percentage of air and will take up considerably more space than a carton of syringes held in bulk.

4.13 Unless a decision is made on the various types of packs to be used at a particular point-of-use, it is all too easy for the hospital planner to assume a minimum bulk and to find, when the storage units are in place, that maximum sized packages are in use, and that the storage units supplied are insufficient for their purpose.

2 FRAGILITY a Do not drop
b Handle with care
c Not applicable

4.14 As mentioned at the beginning of this chapter all characteristics refer to a specific item and where applicable this refers to a container and its contents. In the context of these characteristics this reference is particularly relevant as many items not in themselves fragile are stored within fragile containers. The degrees of fragility described are defined as follows:-

Do not drop - Easily broken or damaged unless carefully handled and stored

Handle with care - Normal care to prevent damage or spillage

Not applicable - For all practical purposes unbreakable

Consideration must also be given to handling these items in transit whether by mechanical means or by hand. It may be necessary to mark the containers with information on how they are to be handled and where they may be safely lifted. This requirement is more fully discussed in 3 POSITION HELD.

4.15 Some of the standard handling symbols are given below.

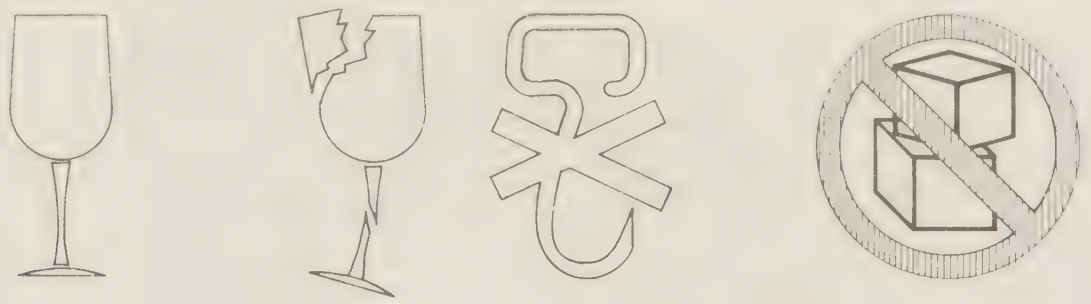


DIAGRAM 4.2 Some standard handling symbols

3 POSITION HELD a This way up
b Not applicable

4.16 This characteristic refers to the position in which an item should be held during handling, transit and storage. It is related to some extent to characteristic 2 FRAGILITY in that the fragility of an item may make it necessary to hold it in a certain position to prevent it breaking or spilling. Careful consideration must be given to handling these items particularly when mechanical systems are used.

4.17 Obvious examples of items that must be kept *this way up* include full bedpans and collection bottles, whereas items such as cartons of toilet paper may be kept any way up. Some items may fall into one category or another according to their packaging; milk in bottles must be kept *this way up*, but milk in tetrahedrons can be stacked in any way, and incidentally take up approximately 60% less space than milk in bottles, and weigh approximately 50% less. Storage of items possessing this characteristic should be considered before planning to use chutes or pneumatic tubes for transporting items. Manufacturers usually mark cartons of goods with handling instructions, and these factors must be considered when designing the storage system, that is, handling, transit and storage. Examples of some of these marks are given below.

DIAGRAM 4.3 Further standard handling symbols

4 DANGER
- a Dangerous
- b Harmful
- c Not applicable

4.18 The dangerous characteristic of an item is considered here as its danger to people and its contamination of other items within a hospital. To a great extent these items come under careful government control and the extent of the danger is reflected by the extent of the security required. Radioactive materials are *dangerous* if improperly used but have a therapeutic value to patients in the proper dosage, and become useless afterwards; certain drugs come into this category also, when outdated they are useless and therefore have a danger value to a patient. Frozen foods also come into this category. If they are not kept in the correct environment and not consumed before a certain date, they too can be *dangerous* or *harmful* to people, according to the degree of deterioration.

4.19 Containers, packages and the identification of medical products are considered in the Medicines Act 1968.[50] The following sections are quoted below:-

"Labelling and marking of containers and packages

85.- (1) The appropriate Ministers may make regulations imposing such requirements as, for any of the purposes specified in subsection (2) of this section, they consider necessary or expedient with respect to any of the following matters, that is to say -

(a) the labelling of containers of medicinal products;
(b) the labelling of packages of medicinal products;
(c) the display of distinctive marks on containers and packages of medicinal products.

(2) The purposes referred to in the preceding subsection are -

(a) securing that medicinal products are correctly described and readily identifiable;
(b) securing that any appropriate warning or other appropriate information or instruction is given, and that false or misleading information is not given, with respect to medicinal products;
(c) promoting safety in relation to medicinal products.

Requirements as to containers

87.- (1) The appropriate Ministers may make regulations prohibiting the sale or supply of medicinal products otherwise than in containers which comply with such requirements as those Ministers consider necessary or expedient for any of the purposes specified in section 85(2) of this Act, or for the purpose of preserving the quality of the products, and in particular, may by the regulations require such containers to be of such strength, to be made of such materials, and to be of such shapes or patterns, as may be prescribed.

Distinctive colours, shapes and markings of medicinal products

88.- (1) Regulations made by the appropriate Ministers may impose such requirements as, for any of the purposes specified in section 85 (2) of this Act, those Ministers consider necessary or expedient with respect to any one or more of the following matters, that is to say -

(a) the colour of the products;
(b) the shape of the products; and
(c) distinctive marks to be displayed on the products."

4.20 Amongst the items which name the characteristics of being *dangerous* to people using and handling them are radioactive materials. There are many government publications on the use of these materials. The Radioactive Substances Act of 1960[74] states that the radioactive material or container in which it is supplied must bear a label indicating that it is radioactive material and, if required, indicating the description of radioactive material to which it belongs. Codes of Practice describe the protection required when such materials are used, one of these is written for medical and dental use[32] and another for research and teaching.[23] The latter code sets out clearly defined requirements for the storage of sealed sources of ionising radiations and unsealed radioactive substances as follows:-

"12.1 When not in use, sealed sources and unsealed radioactive substances should be securely stored. Stores should be in the charge of a Responsible Person and radioactive substances should only be moved into and out of the place of storage with his authority.

12.2 Places of storage must be sited and designed so as to ensure that both during storage, and in the course of transfer to and from store, sources do not give rise to excessive exposure of any person. The protection provided must be such that no person receives in this way more than a small fraction of his permissible dose.

12.3 When radioactive gas, dust or vapour is liable to be present, the place of storage should be efficiently ventilated to the outside air by mechanical means.

12.4 The place of storage should be chosen and the store constructed so as to minimise the risk from fire and flooding. Advice on these matters may be sought from the Chief Fire Officer or Firemaster.

12.5 A suitable warning notice must be displayed where it can easily be read outside the place of storage (see also paragraph 9.5.8) except where the levels of radioactivity do not warrant it."

(Paragraph 9.5.8. states that when not in use unsealed radioactive substances must be kept in appropriate containers clearly marked so that they may be readily identified).

4.21 Some of the most commonly used symbols for dangerous substances are as given below:

DIAGRAM 4.4 Symbols denoting dangerous substances

4.22 Further mention is made of the amended Code of Practice in Scottish Hospital Memorandum (SHM) 34/1972 and it comments:

"Safety requirements are qualified by the words 'must' or 'should' signifying their importance in the opinion of the experts who prepared the Code. 'Must' indicates an essential requirement, 'should' a desirable requirement. Cases may arise where a departure from a 'must' requirement is expedient, yet would not jeopardise the interest of radiological protection. Such departures are only permitted when specifically authorised by the controlling authority in consultation with the radiological safety committee."

5 SHELF LIFE a Critical time
b By rota
c Not applicable

4.23 The shelf life of many items within a hospital is critical, the fact that it is *critical* also implies that it is dangerous to life if the shelf life is exceeded; this applies mainly to pharmaceuticals. This characteristic is closely allied to that of DANGER; the more moderate one, *by rota*, applies to items which are replenished, and for which it is good sense to use the longest stored item first.

6 URGENCY a Urgent
b To hand
c Not applicable

4.24 The urgency of an item is related to its need as a means of saving life. Both a cardiac arrest trolley and a fire extinguisher came under the heading of *urgent*. *To hand* applies to articles which are needed to prevent less critical dangers or accidents: bedpans and vomit bowls would come under this category.

7 FREQUENCY a Constant use
b Frequent use
c Occasional use
d Emergency use only

4.25 The decision to be taken on what is meant by "Frequency" must reflect the type of storage which is being considered. As this paper is basically on storage at point-of-use, frequency of use relates to live storage which will have a reasonable turnover.

Constant use is defined as every few minutes

Frequent use is defined as at least every four hours and not less than twice a day

Occasional use is defined as no more than once a day and not less than once a week

Emergency use only only to be used in case of an emergency

4.26 The number of times that an item is required in a day will be reflected in the storage position at point-of-use. Whether the storage is designed to cater for this or not, an item which is in *constant use* will gradually move from its allotted space to the most convenient one. It is suggested therefore that consideration is given to such items when the storage is being planned, so that the designer may be aware of the requirement when designing and placing his storage units in situ. Further effects of single use items which are in *constant* or *frequent* use will be reflected in the system of supply at point-of-use, and the frequency of the supply and disposal collection. This "Frequency" characteristic must be related to the characteristic of urgency. This factor is also closely allied to the cost of storage. Money locked up in items stored for an unnecessarily long time is devalued and may eventually be entirely wasted through obsolescence.

Note Any *emergency use only* item stored to avert danger or a crisis must not be excluded because it may never be used. This applies to fire extinguishers, 'emergency trolleys' etc.

8 SECURITY a Lockfast
b Constant supervision
c Not applicable

4.27 *Lockfast* security can be described here in three ways, firstly, the high degree of security required for items which are dangerous to the people who are handling them and upon the environment generally, as for example radioactive materials, secondly as a security against misuse as in the case of certain drugs. Items of this type are a hazard to the community if stolen or lost, and therefore this characteristic is closely related to characteristic 4 DANGER. And the third description for *lockfast* concerns security as a measure to prevent theft.

4.28 *Constant supervision* relates to items which are liable to be pilfered, generally because of their use to others in different situations. This can vary between pilfering for personal use, and pilfering resorted to as the only method of getting a particular item for use in a different department. This latter case is a not unknown example of lack of communication between the people in charge of ordering and stores, and the user; it should be solved by open discussion and understanding of user needs.

4.29 The report on "The Control of Medicines in Hospital Wards and Departments"[79] discusses storage on wards and in operating departments as follows:-

> "2.13 *Storage on wards* We consider that medicines can most conveniently be divided into three categories and storage arranged accordingly, namely *a*. those controlled by the Dangerous Drugs Act 1965 and Regulations, *b*. other controlled medicines and *c*. medicines not subject to legal storage requirements. Those comprising the first class are required by legislation to be kept in a locked cupboard, but additionally we believe for security purposes that the medicines in all three groups should be stored in separate locked cupboards. Where refrigerated storage is required this should also be capable of being locked. A standard cupboard of unit design is available which we regard as most suitable (details can be found in Cubith Manufacturers Data Base - Storage and Worktop Units, Edition 5/1 of April 1970 pages twenty-four and twenty-five). Cupboards should be placed in such a position that they are constantly under supervision. Medicine cupboards should not be used for the storage of other materials such as reagents, general disinfectants and cleaning materials for which other locked cupboards should be provided.
>
> 2.14 *Medicine trolleys* Trolleys used for medicine rounds should be provided with lockable compartments permanently fixed to the trolley frame. The trolleys when not in use should be padlocked to the wall or floor.
>
> 2.17 *Storage in operating departments* In multi theatre suites Dangerous Drugs should be stored in a locked cupboard placed in one of the supplies rooms, with the theatre superintendent having charge of the keys. Each anaesthetic room should have a locked cupboard for other medicines. At the beginning of a theatre session these medicines should be checked and put out in agreed quantities ready for use. For this purpose a specially designed tray is recommended, the medicines being replaced as required by the sister-in-charge. In a single theatre unit the same system should be used, the keys being in the charge of the theatre sister."

4.30 SHM 38/64[85] describes two ways of dealing with the problem of pilfering in relation to linen. With the system of topping-up which this circular recommends, and the disappearance of inventories for linen at ward and department level, this problem cannot be ignored. This SHM states that "these relaxations will as a necessary corollary impose on hospital authorities obligations to ensure that as a result losses do not increase. ...It will thus become more important that sisters, laundry managers, domestic superintendents and sewing room mistresses in charge are kept aware of their duty to exercise vigilance to safeguard articles coming into their care." As a further security measure it recommends that hospital authorities should consider either the cording or sealing of laundry containers during transit and the insistence on receipts at each change of hands for the number of containers, and that all staff should be encouraged to leave large shopping bags at the central changing area.

4.31 Most specialised stores giving *lockfast* security, such as safes and strong-rooms, are also fire proof, so that it is not necessary to consider security against fire as a separate characteristic. Inflammable and explosive items are characterised under heading 4 as *dangerous*.

9	TEMPERATURE RANGE CONTROL	a	Narrow range control
		b	Restricted range control
		c	Not applicable

4.32 The storage of items requiring *narrow range* control is defined as + or - 2°C and for those requiring *restricted range* control as more than + or - 2°C to less than - 15°C. Temperatures will vary considerably in relation to the type of item being used and the environment in which it is to be stored. The control temperature used for the purpose of working this system which is based on hospital storage is given as 20°C (68°F). This is the approximate temperature at which most clinical areas and pharmacy departments aim to keep as an average temperature. It must be remembered that the temperature is frequently exceeded in certain areas of a room particularly if it is heated by individual heat outlets such as radiators or convectors. The temptation to use the shelf over a radiator for storing small items may lead to the deterioration of many pharmaceuticals. If it is impracticable to control temperature for transit purposes, this period of transit should be kept as short as possible and the item returned to its proper temperature immediately it reaches its destination.

4.33 From the point of view of engineering services it is the difference between these environmental temperatures and the required temperature range control of the item which decides the type of storage or transit container required.

4.34 The control of temperature is important when dealing with chemicals and organic materials which are liable to break down through bacteria. For example this control is required to have a *narrow range* when certain blood products are stored.

4.35 Control of temperatures within the *restricted range* will include items such as paraffin wax. Cryogenic temperatures are now considered to mean from -150°C to absolute zero (-273°C); temperatures in this range may be used for blood banks in the future. Again as mentioned in the beginning of this part of the report refrigerators give off heat in order to provide low temperature; the greater the refrigeration temperature required, the more massive the compressors will need to be, and it is these compressors which produce the heat.

4.36 Much has been written on the storage of pharmaceuticals. A good general guide to the subject may be found in the Journal of Hospital Pharmacy.[75]

Note Because the tendency is for central heating systems which do not have refrigeration plants (these are expensive to install) heat build-ups during the summer months can be quite formidable. This can also occur throughout the year in central core rooms with no direct outside ventilation. Many items which require to be stored at below 20°C (68°F) will need protection from heat.

10	LIGHT CONTROL	a	Safe height
		b	Protect from light
		c	Not applicable

4.37 The need to keep items in *total darkness* is particularly prevalent in chemical substances, for example certain photographic chemicals become useless if allowed to come in contact with daylight and all but a few special types of artificial light.

4.38 Items to *protect from light* are usually stored in darkness or partial darkness but are used in normal subdued daylight (ie away from direct sun rays) or artificial light. These items include fabrics or chemicals which fade when left in direct daylight and certain types of duplicated records such as dyeline prints of drawings.

11	MOISTURE RANGE CONTROL	a	Narrow range control
		b	Restricted range control
		c	Not applicable

4.39 The type of storage required to keep an item moist or free from moisture depends upon the amount of humidity in the environment in which it is stored. When considering items to be stored at point-of-use in a hospital it may be necessary to consider moisture control for a few selected items.

4.40 The majority of items requiring *narrow range* moisture control are chemicals that are naturally hygroscopic and that will become unusable if allowed to become damp. There are few items needing *narrow range* control compared with the number needing *restricted range* control, examples of the latter vary from bread which becomes stale if kept too dry and mouldy if kept too moist, to early documents which are often written on parchment and suffer bad deterioration if kept in basements too near boiler houses or hot pipes. Flour, plaster and cement all suffer from being stored in a moist atmosphere, whereas vegetables and fruit suffer from over dry storage. However under normal hospital environmental conditions these should not cause problems to the designer.

Note Because many central heating plants are not provided with humidifiers the present trend is towards high temperatures with low humidity. Signs of this can usually be seen in finished joinery where door panels shrink away from the outside frame, or where door frames themselves shrink from the plaster at the sides. Generally therefore it is items which require slightly moist cool conditions which tend to suffer.

12 RADIATION a Protect from radiation
b Not applicable

4.41 The storage required for items needing *protection from radiation* is very similar to that required for storing radioactive items (see section 4 DANGER) but the control and handling of susceptible items is not restricted by law. Examples of items needing protection from ionising radiation are photographic films of paper.

4.42 The symbol used for radioactive substances is given below

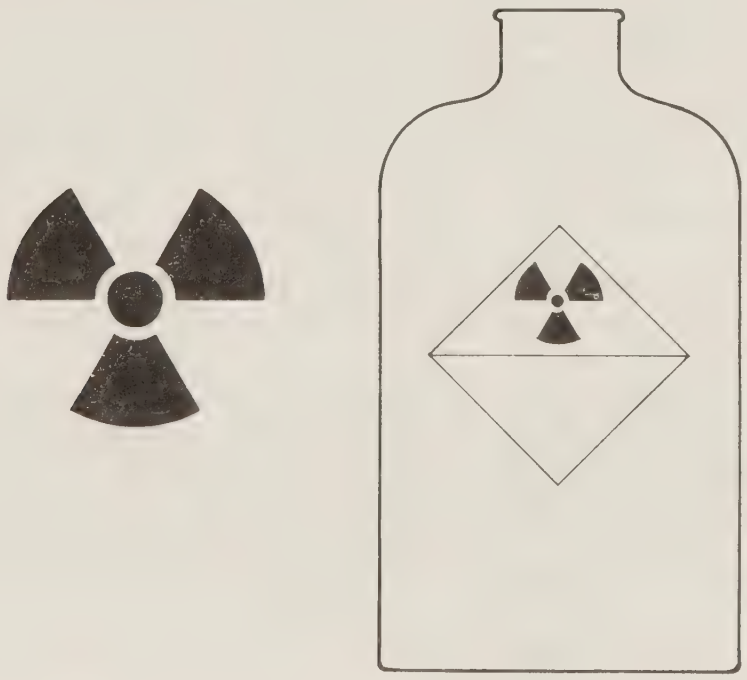


DIAGRAM 4.5 The standard symbol for radioactive substances

13 VIBRATION CONTROL a Vibration free
b Not applicable

4.43 The majority of hospital supplies do not require to be *vibration free* during storage or transit. The main types of item which commonly require to be *vibration free* are instruments whose calibrations may be upset and pharmaceuticals in a state of suspension which may be distributed by vibration. Instruments are normally supplied with levers or other types of controls which fix the calibrations in a dormant position when they are not in use. Vibrations vary considerably in character, but the most likely source will be from heating and ventilation plants and from compressors used for refrigerators and pumps. If compressors of different phases are placed close together and are insufficiently mounted their vibrations will give intermittent vibrations similar to large diesel engines which are running badly. This characteristic is closely related to NOISE (14).

14 NOISE CONTROL a Intolerable level

b Tolerable level

4.44 The handling and transit of items is part of the process of storage and the noise caused by these processes becomes part of the characteristic which must be considered by the designer. Many containers which hold items or are used during transit produce a level of noise well above the acceptance level within certain parts of a hospital. The *tolerable* level in a quiet ward at night may be low in relation to the *tolerable* level in a kitchen during work hours. Generally the amount of noise *tolerable* is reasonably apparent from experience, and studies have been carried out in hospitals on this subject.[77 15 47]

4.45 There are also certain frequencies of noise level which cause more disturbance, low frequencies set up irritating vibrations through floors and furniture, whilst high frequencies which whine continuously cause the listener to rub his ears (both these types of noise can be heard coming from the majority of central heating pumps). For the purpose of this report it is sufficient to remember that a noise which is *tolerable* by day because of an overall background noise may become *intolerable* by night, and be heard over considerable distances.

4.46 Noises which are *intolerable* include metal containers loosely stacked on small wheeled trolleys or trucks which run over rough surfaces. One of the most *intolerable* noises in this respect, is that of this type of trolley running over the studded rubber safety treads found in many hospital corridors which are on a slope. Proper setting out of these floors should provide a suitable central area of smooth flooring for all the trucks and trolleys used, and a little more care on the part of some drivers would avoid running over the studs.

4.47 This characteristic considered in the context of storage or point-of-use is closely associated with *frequency* since noise which is *tolerable* when heard occasionally becomes *intolerable* when heard continuously, eg steel bedpans being cleaned and stored. The principle of reducing noise caused by handling is that the items and their containers should be made as quiet as possible as a first step, and then that the trolleys and other handling equipment and storage units should be silenced. Stainless steel and metal generally are noisy materials; where possible, alternative materials are recommended, eg polypropylene, nylon or polythene for utensils and buckets.

4.48 Many items which are treated gently and quietly when supplied are very noisily handled when returned empty - milk bottles, crockery and tin cans are obvious examples. It is therefore important to pay attention to the handling of such items when considering noise.

4.49 Many mechanical systems become noisy through lack of planned maintenance; wherever possible noisy equipment should not be placed close to quiet areas. Hospital Design Note 4[57] puts forward various recommendations to reduce noise. These include the use of absorption type refrigerators if extreme quiet is required and the use of flexible joints between bedpan washers and similar equipment where they are jointed to service runs. Castors should be at least 100 mm diameter (4 ins) on small dressing trolleys, and 180mm diameter (7 ins) on patients' trolleys though in this case 230mm diameter (9 ins) is preferred. Oxygen cylinders should be moved on trolleys with large castors and padded frames.

15 EFFLUENT a Harmful

b Unpleasant

c Not applicable

4.50 Some liquids and powders can produce *unpleasant* or *harmful* effluent when stored, either because the container is cracked or leaky, or because the contents dribble after being poured from a spout or tap. *Harmful* effluents are strong acids and alkalis or corrosive cleaning chemicals. Items under this category heading should be considered in conjunction with category 4 DANGER. *Unpleasant* effluent includes such items as blood, faeces, swill and other smelly, sticky or irritating materials. The principle of storing items at risk from effluent is, first, to improve the design of the container in order to reduce leakage or spillage and, second, to design the storage system to accept *harmful* or *unpleasant* effluent. Generally, attention must be given to providing quick and efficient methods for cleaning up spillage as it occurs.

16 FUMES & EFFLUVIA a Harmful
b Unpleasant
c Not applicable

4.51 Unlike the control of noise which does not need consideration whilst the item is static and waiting for use, fumes can be emitted during storage. The reaction of many substances will cause fumes of varying degrees of severity. Some of these will require storage within a confined space incorporating highly developed mechanical extracts, for example fume cupboards, whilst others will require simple natural or mechanical extracts depending upon the position of the item to be stored in relation to the orientation of the building and the availability of natural ventilation. Care should be taken not to provide high level outlets emitting fumes windward of fresh air inlets for ventilating shafts.

4.52 *Unpleasant* fumes or effluvia arise mainly from organic items deteriorating in store, such as food, swill, chemical compounds and waste held in bins prior to disposal. Most of these fumes can be controlled by providing containers which are fume or smell proof, special storage units should not be required. Items held as waste for disposal should be removed frequently; the provision of bins with heavy rubber lids and liners are often more efficient for waste standing outwith a building than sacks and sack holders. Stray animals and rats can burrow in to the latter and in so doing spread the waste and its smells in sufficient quantity to attract flies.

4.53 The most common *harmful* fumes are those from petroleum products and other volatile liquids; these too are liable to explode. The storage of these items is controlled by law.

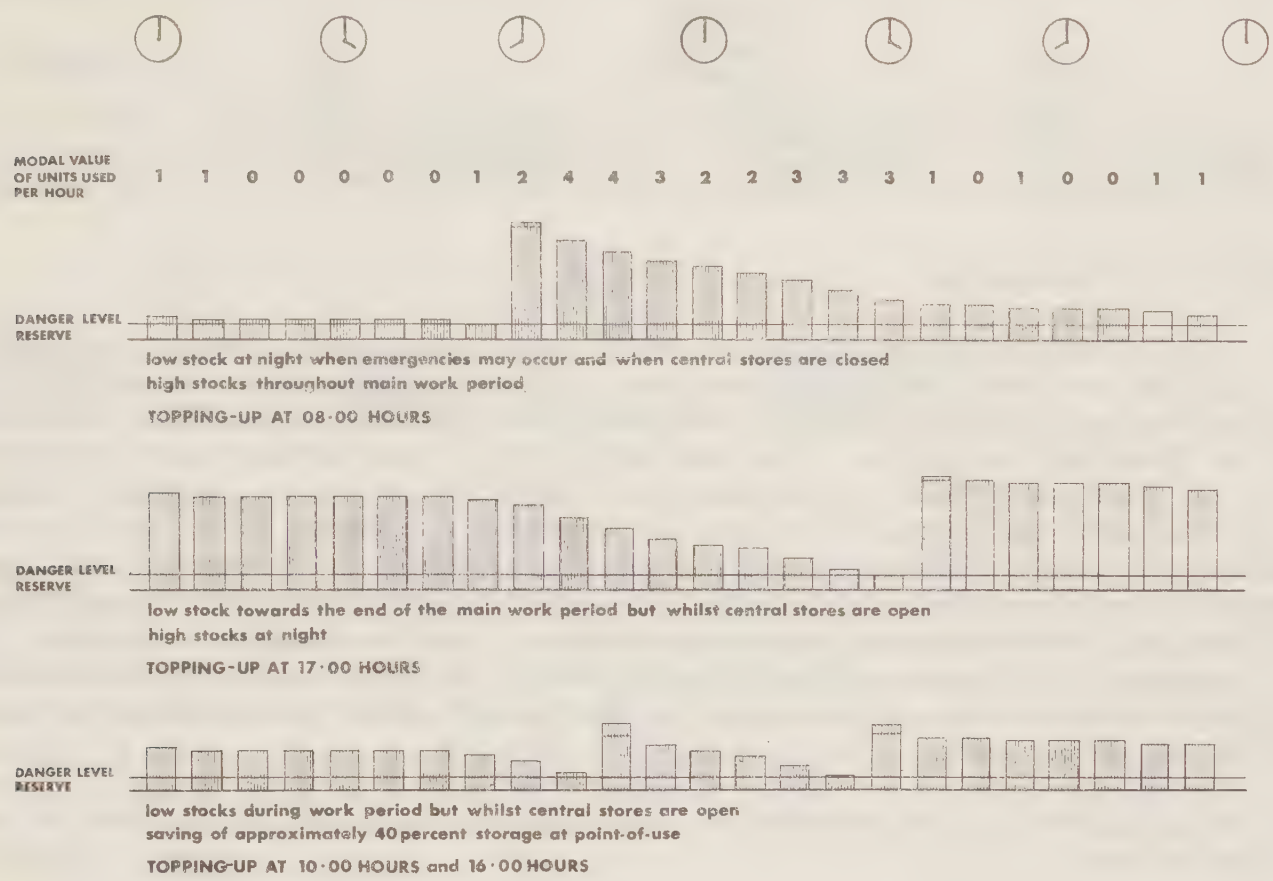
17 DUST CONTROL a Dust free
b Domestically clean
c Not applicable

4.54 The amount of dust particles in the air which are acceptable in the different working areas of a hospital will vary enormously and again for the purpose of this report the acceptance level for general laboratories, nurse working areas and food preparation areas are given as the control. Above this level of control will be the *dust free* requirements for theatre areas, specialised laboratories etc., and below it the requirement for workshops, boiler houses etc. The rigidity of the control will vary between these types of area, but will be nonetheless important when considering the storage of items which must not be allowed to come in contact with dust. Delicate laboratory equipment should be kept *dust free* from the time they arrive at the hospital, and not only during their storage at point-of-use. These items can be ruined by dust penetration, and are expensive to replace. Other items requiring to be *domestically clean* such as food, linen, crockery, should be stored away from dusty activities.

Note Dust is a potential hazard in hospitals because it may carry infection.

PART 5 METHODS OF REPLENISHING STOCKS

5.1 The type of storage required for a particular item can be worked out by using the Storsolver system described in the supplement. What this method does not do is indicate the type of distribution system to be used when replenishing these stores. If an entirely new system is proposed, or if an amendment to the existing system is to be considered, a time-scaled resource chart may prove the most effective way of setting out the problem. It will show the various requirements for each ward unit and department and the number of times a day the stores require replenishing.


MODAL VALUE OF UNITS USED PER HOUR
1 1 0 0 0 0 0 1 2 4 4 3 2 2 3 3 3 1 0 1 0 0 1 1
DANGER LEVEL RESERVE
low stock at night when emergencies may occur and when central stores are closed
high stocks throughout main work period
TOPPING-UP AT 08·00 HOURS
DANGER LEVEL RESERVE
low stock towards the end of the main work period but whilst central stores are open
high stocks at night
TOPPING-UP AT 17·00 HOURS
DANGER LEVEL RESERVE
low stocks during work period but whilst central stores are open
saving of approximately 40 percent storage at point-of-use
TOPPING-UP AT 10·00 HOURS and 16·00 HOURS

EFFECT OF DIFFERENT TOPPING-UP TIMES UPON A PARTICULAR ITEM STORED IN AN OUT-PATIENTS DEPARTMENT WHEN THE MODAL VALUE OF THE TOTAL UNITS CONSUMED IS 33 AND THE RESERVE IS 5

DIAGRAM 5.1 Effect of different topping-up times upon a particular item stored in an out-patient department when the modal value of the total units consumed is 33 and the reserve is 5

5.2 Any method of replenishing stocks used must be part of a whole hospital system of supply, storage and disposal. Discussions must be held and decisions made at the earliest stages of the planning process so that the designer may incorporate any structural requirements into the building. The method selected must be fully planned from operational policies to detail design if it is to work efficiently throughout the economic life of the building.

5.3 Storage areas at the point-of-use are within a complex and expensive part of the building, and the amount of space required in some of these areas has to allow for gaps in an otherwise efficient and regular replenishing service because of public holidays - a holiday which the porter delivering stock and clearing rubbish has allocated to him - but one which does not affect the 24-hour 7-day running of many parts of a hospital. To some extent then storage space has to be related to the public holiday periods which usually spread over 72 hours and occur four or five times a year. It is often towards the end of these holiday periods that emergency and casualty services are being used to their utmost capacity. However in general storage at point-of-use should only be sufficient to provide for immediate use; it should not encourage hoarding. Whatever system is incorporated, it will stand or fall as an effective system in the eyes of the user by its ability to provide the right item in the right place at the right time.

5.4 A user has only to be let down once or twice to lose confidence in the whole system, no amount of reassuring will make up for these discrepancies; and the result is exactly what present trends are trying to avoid - excess stock within expensive parts of the building envelope and within areas which have not been planned to take them.

5.5 Different methods of replenishing are administered in different ways, some demand a considerable amount of the users' time, either in the form of

requisitions and inventories and/or in physically checking, sorting and storing items. Some hospitals have provided wards with non-nursing staff to attend to these duties.

TOPPING-UP

Definition: keeping stock items up to predetermined levels by providing a regular replenishing service

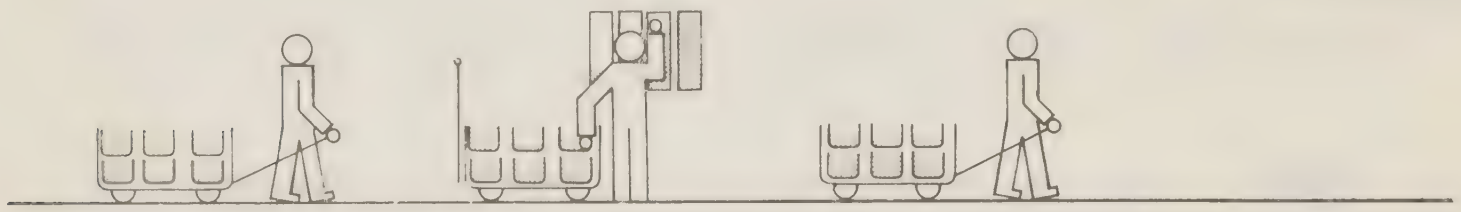


DIAGRAM 5.2 Topping-up

5.6 Scottish Hospital Memorandum 16/1972[80] lists non-nursing duties, and SHM 38/64[85] and its enclosure discussed various ways of reducing the time nurses spend on clerical duties in connection with supplies and services at ward and department level in Scottish hospitals. In the latter SHM it was noted that a considerable amount of time and effort was expended on indenting, checking, sorting linen; this was particularly so if the linen was not checked at laundry level for necessary repairs. It also recommended that inventories should be dispensed with for such items as linen, hardware and crockery and that topping-up systems should be used for these and for dressings, cleaning materials and stationery. Although the actual amount of time spent on clerical work by the nursing staff on these activities was not excessive - on average 20 minutes per week - the irritant factor was found to be high.

5.7 The enclosure to the memorandum summarised the general principles of topping-up as follows:-

"(i) Accurate estimates and periodic review of the consumers' requirements are essential.

(ii) Responsibility for stores should be clearly allocated to the appropriate administrative officer.

(iii) There must be frequent and regular replenishment of supplies to counteract the natural inclination to hoard.

(iv) Regular spot checks at consumer level must be carried out to ensure that the system is working satisfactorily.

(v) Storage accommodation should be of a common type, secure and with limited access. This can be achieved by installing what is virtually a local source of supply from which replacements are drawn at ward level.

(vi) Responsibility for ordering and for delivering should be vested in different officers.

(vii) Authorisation of issue before delivery should be made by the hospital secretary or delegated officer.

(viii) Abnormal and ad hoc requests should be infrequent, must always be accepted but will be easily recognised.

(ix) Expendable items should not be on ward inventories. Topping up is in fact a form of inventory.

(x) Installation should be gradual and on an experimental basis with a continuing and careful scrutiny of the comparative cost of the old and new system."

5.8 The topping-up system has the excellent quality of keeping stock items at point-of-use to a minimum. It has also the advantage of keeping the movement of the delivery truck or trolley within the hospital to a minimum. A loaded trolley is taken from one ward unit or department to the next with the items on it being used to stock up to the predetermined levels; thus the trolley can continue on its ring route only returning to base when it is empty. The system has the

advantage of not involving ward and departmental staff in paper work, but it does not necessarily ensure the use of items being used by rotation at point-of-use.

5.9 The service of topping-up must be related to the diurnal variation of turnover-of-use, and it may be required to provide a reciprocal method for collecting waste. Peak work hours in outpatient departments for example may require a topping-up service every four hours, whilst others may need one every twenty-four hours or less. Unless a certain amount of training is carried out to ensure that porters know the levels for topping-up the stores, departmental staff will have to be at hand to check levels.

EXCHANGE

Definition: the exchange of the remainder of any stock item for a new stock of items by means of a regular service

DIAGRAM 5.3 Exchange

5.10 Stocks are kept to a minimum by using this system. It does involve more movement of delivery trucks or trolleys within the hospital than a topping-up system. If whole loaded trolleys are delivered to ward units or departments, then empty or partially empty trolleys have to be returned to base. It has the advantage of ensuring the use of fresh stock at ward or department level whenever an exchange is made. It does not require any special training for portering staff, nor does it require ward or department staff to be at hand when deliveries are made.

STANDARD ISSUE

Definition: the restocking of ward unit or departmental stores by means of standard issues

DIAGRAM 5.4 Standard issue

5.11 This system is only suited to items which have a regular turnover within a certain time. It does require a member of the staff at point-of-use to be at hand to check the order.

5.12 Abstract of Efficiency Study No 40[55] noted that many domestic supply items were demanded frequently, and in an effort to reduce clerical work standard packs were issued at regular intervals. No requisition slips were required and the standard packs could be made up at slack times during the day. Any accumulation of particular items at point-of-use was reduced by the domestic superintendent, floor supervisors removing the materials for use elsewhere. The success of the system prompted the hospital to expand the standard pack to other items.

ON REQUEST

Definition: the issuing of certain items on receipt of a request

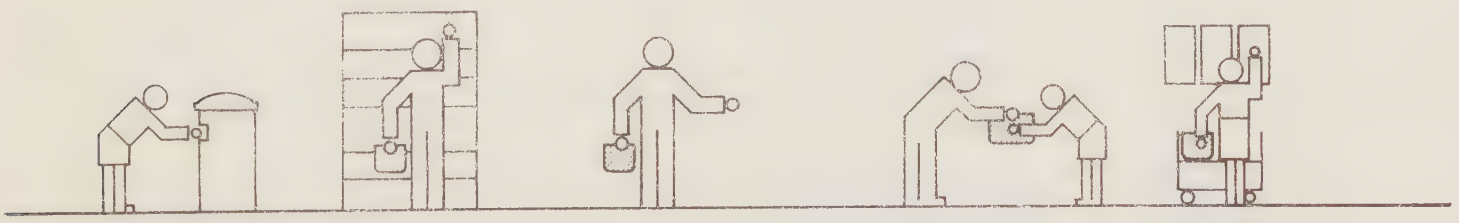


DIAGRAM 5.5 On request

5.13 This system is based on written requests from the ward unit or department to the central store. It is suitable for items which are only required occasionally; it may also be used for emergency requests eg pharmaceuticals, but it involves the departmental staff with a considerable amount of paper work.

5.14 Difficulties arising from the use of requisition by handwritten lists are well documented in Abstract of Efficiency Study 135.[29] In the case cited, pharmacy requirements were ordered by means of handwritten requests. These lists were written out by ward unit and department staff in random sequence, legibility and spelling created problems, and essential information was often omitted.

5.15 Random order picking against the list caused considerable unnecessary movement in the pharmacy store, and items were sometimes missed altogether. The pharmacist had no check on the amount of stock held at point-of-use, and in some cases the storage unit was overloaded making it difficult to identify and extract the required item.

5.16 Replenishing by order cards was a system devised to overcome the difficulties of handwritten lists. The basis of the system is an approved stock list at ward unit level agreed by the chief pharmacist and the clinicians. Each ward displayed the list as a colour-coded card system, replenishing cards were extracted as required and sent to the pharmacy. Stocks for each ward were kept at an agreed level; as each item was supplied the cards were stamped and returned with the orders.

5.17 In the report "The Control of Medicines in Hospital Wards and Departments",[79] it states:-

> "2.12 *Ward medicines stocks* The aim should be to keep the level of these stocks as low as possible. The minimum level for a particular ward should be agreed after discussion between the medical, pharmaceutical and nursing staff and be subject to periodic review. The stocks themselves should be reviewed regularly, preferably weekly, and medicines no longer required returned to the pharmacy. In the operation of a ward pharmacist system as described in paragraph 6 it is the responsibility of the pharmacist to satisfy himself on the method of storage and the condition of the medicines, although the weekly physical checking may be carried out by a person nominated by him."

Paragraph 6 describes the concept of the pharmacist visiting wards at frequent regular intervals, thus allowing him to initiate the supply of medicines to meet current prescriptions and to ensure that the medicines used are qualitatively and quantitatively correct.

PART 6 DESIGN FOR A STANDARD CONTAINER

6.1 In many parts of Britain in recent years there has frequently been pressure on the available pool of male labour in the categories from which hospitals normally recruit portering staff, and to a large extent the same is also true for women who are willing to undertake full-time employment. Most hospital authorities have for a long time experienced difficulty in recruiting male labour for the portering services, and there is little evidence to suggest that their recruiting ability is likely to improve in the future. In view of this it is possible that before long the only way to provide many of the unskilled services within a hospital will be by adapting the duties involved in such a way that they can be undertaken by part-time married women, the most likely source of available labour in the future.[42] In view of this statement on the probable trends of labour in British hospitals, it is considered unwise to design loads which cannot be lifted by women with reasonable ease.

6.2 Similarly, von Bahr stated in his article in Traffic Planning in Hospitals that[2] volume was used as a measurement for the quantity of materials, together with weight. The actual volume unit chosen to be contained in a goods container was scaled to that unit most suitable for handling by the female personnel at the last stages of the handling cycle. Unfortunately the size was not given in his article.

6.3 In their study on containers for clean and dirty linen, the King's Fund[43] gave a specification for containers under the following headings: size, strength, appearance, contamination, loading, security, identification, disinfection and cost. It also discussed the various materials available for these containers, and emphasised the fact that the optimum size for a container was one which could be easily handled by men or women whether it was full or empty.

6.4 Obviously any container which a woman can lift, can also be easily lifted by a man; the converse is not true. Therefore it is the lifting ability of women which will govern the size of any container. Women can carry heavy bulky loads on single occasions, but if they are to carry loads continuously throughout their work shift the weight and size of the load must be modified to prevent undue fatigue. Part 4 (paragraphs 4.8 to 4.12) discussed the characteristics of weight: size in detail, the maximum recommended weight for moderate loads is 10 kg (22 lbs).

6.5 A further consideration which must be taken into account before any new system of stores handling is installed in a group of hospitals is the distance any container may have to be carried or manoeuvred, particularly in older hospitals within the group: here there may also be the additional problem of the need to manhandle a container up and down stairs.

6.6 When considering the handling of storage items which cannot be stored within a standard container Health Services Design Note 3[26] provides the following information:- the maximum width of object that a small woman can carry is 1.10m (43") overall. It states that this object can be held provided that the weight and other dimensional characteristics of the object carried are acceptable to allow it to be carried in an upright posture; that is, that it is not necessary to bend the spine to lift the object; and that the operator's field of vision is not unduly obstructed by the object.

6.7 This document also gives information on the width of circulation space required for persons carrying medium to large sized objects. For large men handling objects the following sizes are given:-

Type of object	*Width of object*	*Width of circulation space required*
light or heavy objects	up to 1.22m (48") wide	1.40m (55")
"	up to 1.09m (43") wide	1.27m (50")
"	up to .91m (36") wide	1.09m (43")
"	up to .76m (30") wide	.96m (38")
"	up to .61m (24") wide	.91m (36")
"	up to .46m (18") wide	.81m (32")
light object only	up to .30m (12") wide	.61m (24")

Although it does not define medium or large sized objects or light and heavy objects, it does state that "with heavy objects, reduction of widths below .46m (18 ins), will not significantly reduce the space required below .81m (32 ins) owing to the posture adopted". From this information it will be appreciated that the width of gangways in stores is related not only to the width of trolleys etc but to the size of load to be carried. In the store at Greenwich Hospital 710 mm (2 ft 4 ins) gangways are being used between fixed shelving. It was considered that as the shelf units were never more than 2,700 mm (9 ft) long there was no need to provide wider gangways when a main gangway was only a few strides away. Pallets and trolleys are to be temporarily parked in these main gangways.

6.8 Some consideration has already been given to the actual size and weight of loaded containers that can be lifted by women, and which will hold approximately 95% of the items likely to be held in hospital departments.[42] Linen is the one item which, when folded on standard machines requires a length of up to 600 mm (24 ins), and it is the inclusion of this item which gave the Greenwich Study Team the size of 600 mm (24 ins) x 300 mm (12 ins) x 300 mm (12 ins) for their container. For linen sent from the central laundry in one of the standard laundry hampers, it is possible to reduce the length of the standard container to 450 mm (18 ins). This has the advantage of being suitable for carrying through a narrower gap than the 600 mm (24 ins) container, that is a 800 mm (32 ins) gap as opposed to a 900 mm (36 ins) gap, and of being more suitable for the arm spread of a woman.

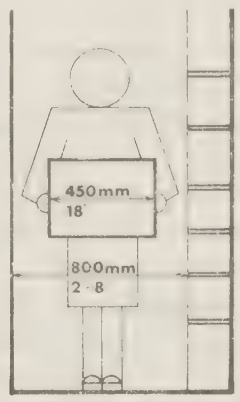


DIAGRAM 6.1 Width of load & circulation space related to carrying capacity of women

6.9 The weight that can be carried varies in relation to the vertical lift which the load has to be carried through, the distance which it has to be carried, and the number of journeys to be made in any one day. If this container is assumed to have internal dimensions of 440 x 315 x 315 mm (17½ ins x 12½ ins x 12½ ins), it would be possible to provide smaller containers to fit within it. These containers could either carry loads for different departments or small or fragile items which are liable to get mislaid or broken in the larger containers. Suggested sizes for these containers is given in the diagram below. Many more variations could obviously be developed, but for the purpose of variety reduction, these are the only ones considered here.

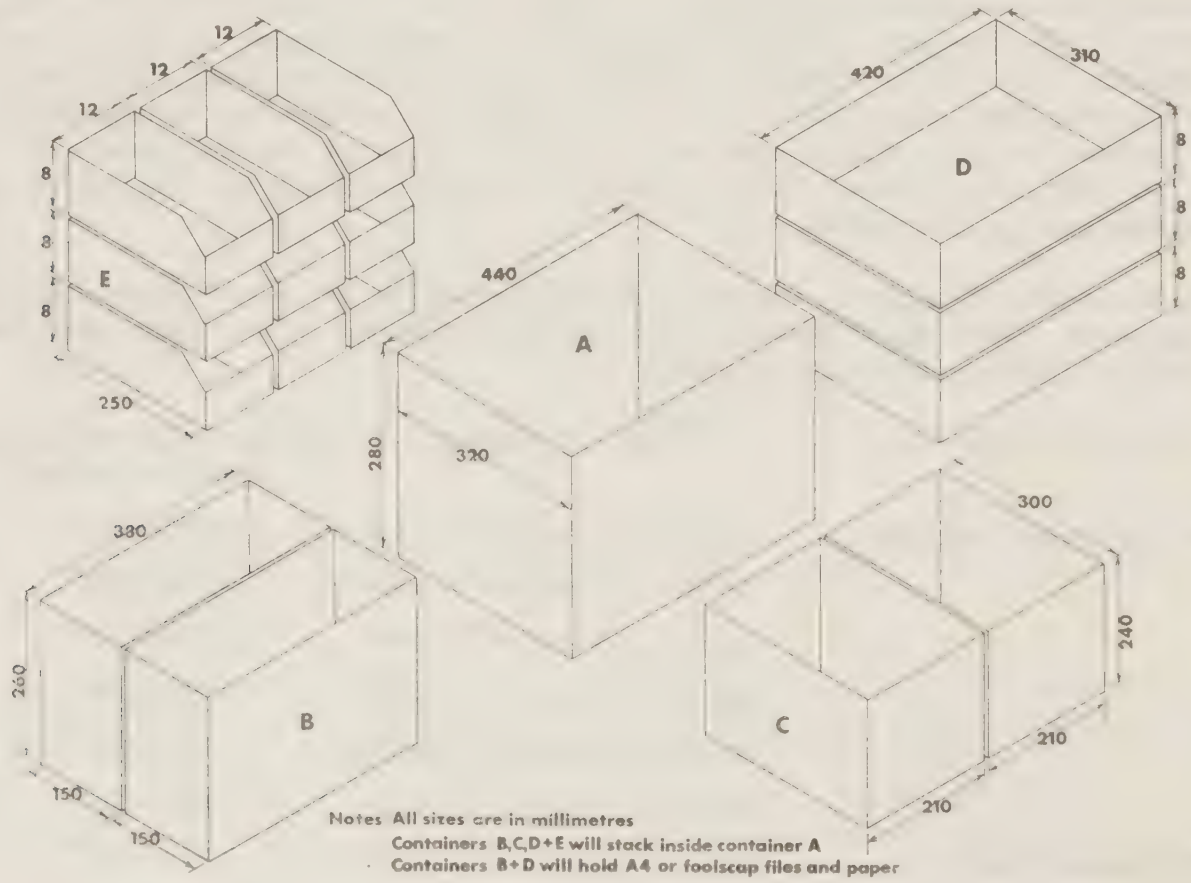
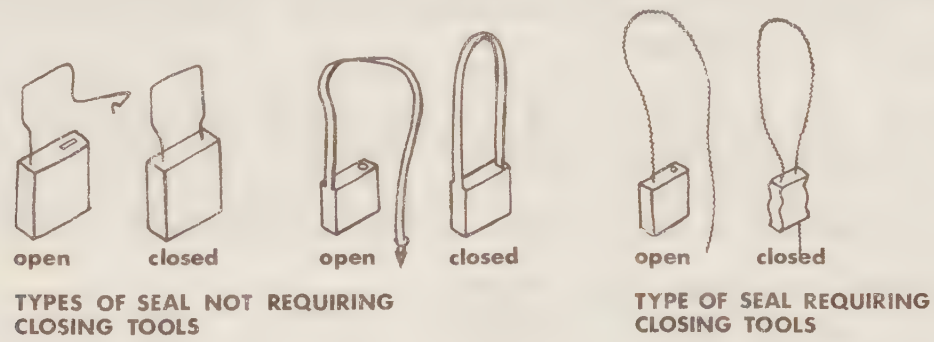


DIAGRAM 6.2 Suggested sizes for standard containers

6.10 All types of items which are held at the central stores will inevitably have to be distributed to some point-of-use store, and others will have to be collected from point-of-use and distributed either to a central disposal area or to other point-of-use stores. Because of the vast variety of items being used in hospitals, some will inevitably come under the category of *dangerous*, either for their ability to cause injury to personnel who come into contact with them through spillage or inhalation, or because they can become addictive. Items in this category include radioactive material, infected material, corrosive acids and certain categories of drugs. The movement and storage of radioactive substances and certain drugs are restricted by Codes of Practice and Acts of Parliament; these are considered in greater detail in Part 4. The movement and storage of other items which may cause danger to personnel and other drugs and therapeutic substances are governed by codes and restrictions agreed by professional and technical institutions and by the hospitals themselves.

6.11 All the items in this category must be moved with care, and if necessary in their own specific containers. If they are to be carried within the standard container these must have lids which can be locked on. Lockable containers are also required to prevent pilfering.

6.12 This requirement provides a further design restraint on the containers, that is, at least two of them must have lids and a means of locking the lid to the body either by the traditional padlock and key or by a single use seal. Illustrations of the container with its lid and of typical seals is given below.



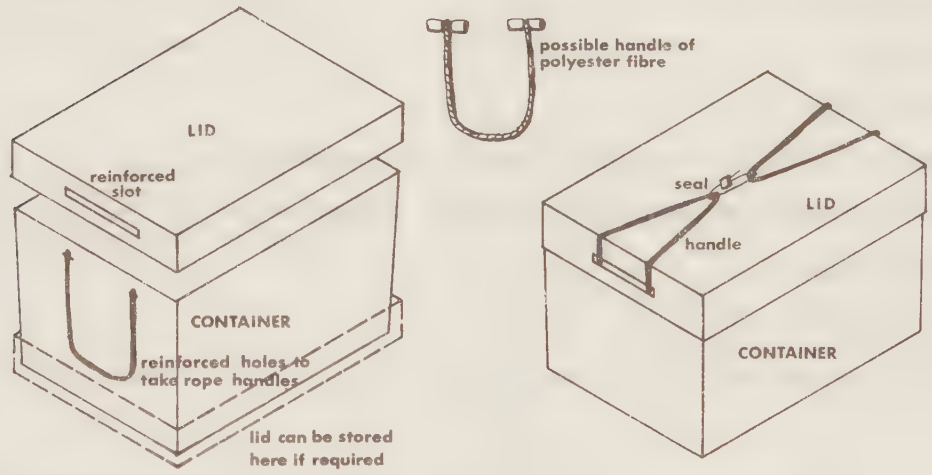


DIAGRAM 6.3 Standard container with lid and selection of seals

The great variety of items to be stored within these containers are obviously not all compatible one with another: it will therefore be necessary to provide different colour-coded containers for some items. These may vary from hospital to hospital, but if possible the code should be on a national or at least area basis as suggested for the waste bags in Part 6.

6.13 In some instances it may be useful to be able to mark a container either for identification of the contents or for identification and stock-taking on a local scale. There are two obvious ways of dealing with this requirement, by direct marking on the bin with a wax crayon or a water-based felt pen, either of which produce marks which are easily removable, or by means of a card which can be inserted in a slot. As most of these containers are to be cleaned and re-used many times, spirit-based felt pens are not recommended for direct marking of bins, these marks require a spirit to remove them and this may damage the material from which the container is made. If cards are to be used, the slots should be designed to take a standard card not smaller than one-third A7[13] (74 mm x 35 mm, 2.91 ins x 1.38 ins).

6.14 If the incompatibility of items is extreme or likely to cause danger from contamination the container may have to be made for a single trip or restricted period only. It is suggested that waxed or unwaxed card cartons are

used for this purpose. Because they are to be discarded after use, they may be required in considerable quantity. It is further suggested that to save storage space these should be made in a flat form which can be easily erected as required.

6.15 All the permanent use containers must be subjected to a planned cleaning programme. Some may require a greater degree of cleaning than others. The material for the container must therefore be capable of being processed through water temperatures of 80Ø°C (176°F). This cleaning process should be carried out in central areas, preferably next to the central stores. Rounded corners to the containers will facilitate any cleaning method used.

6.16 When held at point-of-use, it is assumed that to a great extent the containers will hold the item on the shelf ready for use. Any container which is used to convey goods should not be kept at point-of-use. There will however be a considerable number of these containers waiting to be cleaned, or stored waiting for use, at the central distribution areas. In order to reduce the space that these containers take up, they should have slightly tapered sides.

6.17 The final consideration for the design of this container, is that it should be capable of taking reasonable hard use and be suitable for use on a simple conveyor or hoist system. The amount of wear that each container will take is to a great extent proportional to the capital cost of the item. The more dense the material from which the container is made, the harder it is likely to wear, and the more expensive it will be. The main criterion for the design of container to be used on roller conveyors is that they should have a base which will provide maximum adhesion with the conveyor.

6.18 In conclusion, the setting out of all the design criteria for these containers results in the following list of constraints.

Summary of requirements for largest standard containers

1 comfortable lift for a small woman
2 take a load of up to 10 kg (22lbs)
3 lid and locking device
4 colour code
5 place for label
6 'disposable' single use containers if required
7 permanent containers washable in hot water
8 easy-clean shape
9 slight taper for stacking
10 stand up to hard use on conveyor or hoist

PART 7 STORAGE OF USED ITEMS

7.1 When consideration is being given to the storage space required at point-of-use, an aspect which cannot be ignored is the storage of waste items after they have been used and before they are removed from the ward unit or department. The department in question may have a direct disposal or removal system, but frequently some if not all used items are held at point-of-use until they are transported by a porter to the main disposal area, or returned by him for re-processing to the issuing department. There will also be some departments that will have direct external deliveries of certain supplies and will therefore have to dispose of wrappings and cartons, and store any returnables for collection, probably until the next delivery date.

7.2 This storage of waste material for destruction, and of used material for re-processing or return may well take up considerable space, particularly during the weekends and over the 72-hour public holiday periods.

DIAGRAM 7.1 Accumulation of waste over a 72-hour period

7.3 Hospital Planning Note 1[84] gives the following classified list as examples of outgoing items from a ward, and in doing so it emphasises the importance of the return/disposal route.

"Process	Examples of items
Return to central service for washing, sterilisation where necessary and re-issue	Linen Apparatus Crockery Cutlery Trolleys
Return to central service or to commercial supplier for processing (eg sterilisation) and return	Instruments Dressings (unused but opened) Apparatus Syringes Needles
Return to central supply for replacement	Bottles and containers for: Drugs Medicines Lotions Fluids Cleaning materials Milk Beveridges
Destruction	Soiled dressings Polythene sheeting Aluminium foil Cartons Food Flowers Disposable bedpans and urinals Syringes Needles Paper and wrappings Plaster or paris casts"

Note In forthcoming revised edition syringes and needles will be omitted from the list of items to be returned for processing

A more detailed list of the items which require to be removed from a ward is given in Appendix III.

7.4 The Department of Health and Social Security have classified hospital waste into six classes.[21]

Class A: Ward waste

Ward and sanitary dressings; general ward waste eg flowers, disposable waste-paper articles, floor sweepings; excluding uncontaminated tins, bottles, food waste, plastics and disposable bedpans.

Class B: Plastic materials and dirty paper

Disposable syringes, pituitory tissues, plasticised paper, food wrappings, paper cups.

Class C: Theatre and laboratory waste

Operating theatre waste, human tissue, disposable theatre garments, plaster casts, pathological-laboratory waste, specimens, animals.

Class D: Maternity waste

Placenta, maternity dressings, disposable nappies, general maternity ward waste; excluding uncontaminated tins, bottles, food waste, plastics and disposable bedpans.

Class E: Kitchen waste

All food waste, dirty paper from kitchen; excluding uncontaminated tins, bottles and clean paper, cardboard, plastics.

Class F: Clean paper

Newspapers, letters, documents, cardboard, paper packing; must not have been in contact with infectious patients.

7.5 The amount of waste for a 600-bed general hospital is given as follows:-

375 kg/day (825 lb) of Class A waste
125 kg/day (275 lb) of Class B waste
75 kg/day (165 lb) of Class C waste
100 kg/day (220 lb) of Class D waste
200 kg/day (440 lb) of Class E waste
300 kg/day (660 lb) of Class F waste

Although this disposal-storage may equal the supply storage in quantity, it does not as a rule have to equal in quality. The majority of waste can be pushed tightly into waste sacks, and only those items with exceptional characteristics such as fragile returnables, pathological specimens, radio-active and infectious waste will have any special requirements. There are however some items which take up more space when being stored for disposal or return, dirty linen for example takes up nearly twice as much space as clean folded linen.

7.6 Management Services (NHS) 1[25] suggests in section 8, that the collection, transportation and disposal of refuse etc can be simplified if sufficient receptacles are provided to enable different types of material to be kept separately, and that refuse should be collected at least twice a day after peak-time accumulation. Two systems are suggested, one involving sufficient spare bins to enable an empty bin to be exchanged for a full one, and the other involving the provision of disposable sack or bin liners to eliminate the need for cleaning or exchanging bins.

7.7 The bagging of waste into different categories is a group hospital policy; the number of bags kept at point-of-use will depend on decisions taken. Disposal bags will be required for as many categories of waste as the group has methods of processing it. These categories will not be the same as those given by the DHSS and listed earlier in this chapter; they will be categorised according to their method of processing or disposal and may include dirty linen, fouled linen, infected linen, waste paper, soiled dressings, infected waste, broken glass and needles, food waste and plastic waste.

7.8 If these different categories are placed in different colour-coded bags at point-of-use, then the porter who removes them will know what they contain, and

where they are to be taken for processing or disposal. It is suggested that a standard colour code for these categories would aid any user who moves from one hospital group to another; examples of such a code is illustrated below.

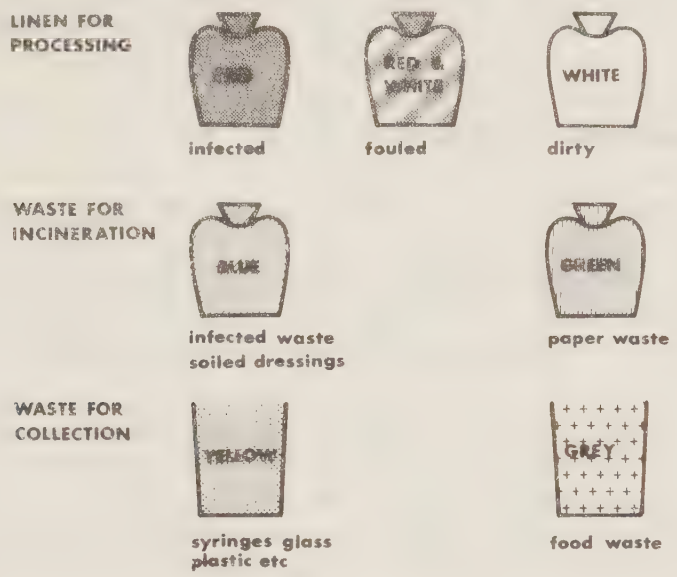


DIAGRAM 7.2 Suggested standard colour code for bagging of linen and waste

PART 8 DISPOSAL OF REFUSE

8.1 The obvious reason for wishing to keep to a minimum the storage of items for disposal at point-of-use is to reduce the amount of space given up to that activity in the more expensive areas of the hospital such as ward units and laboratories. If however disposal-storage is included in this activity there is the added risk of storing infected material, and later moving it through the hospital.

8.2 In the report of the working party on the disposal of refuse, it states under hospital and other medical wastes that,[24]

> "Although there is some variation according to the type of hospital, refuse of a domestic nature forms about 50 per cent of waste from hospitals. Such refuse includes clean kitchen waste, uncontaminated tins and bottles, clean paper, cardboard and plastics. Collection and disposal of this refuse can appropriately be done, if required, by local authorities.
>
> Medical and contaminated or objectionable wastes need to be dealt with under special arrangements to ensure safe disposal and to avoid offence or risk to public health. The Department of Health and Social Security advised us that there was no centrally enforced policy on methods of handling and disposing of medical wastes at hospitals and that individual hospital authorities are responsible for the disposal methods used and for their control. The methods used at present are broadly:
>
> i incineration on the site under the control of a hospital's own medical staff;
>
> ii maceration and disposal through the public sewerage system (this applies to such things as disposable bedpans and other suitable items);
>
> iii disposal by arrangement with a local authority with or without prior sterilisation."

8.3 Management Services (NHS) 1[25] states in section 8, that, disposal of refuse can take up a considerable amount of portering time and may require as many as 70-75 hours per week in larger hospitals. Movement of dirty and infected material within hospitals should be restricted in the interests of hygiene and to reduce the risk of cross-infection. Such devices as chutes, hoists, incinerators and waste disposal machines have been installed in order to do this and minimise handling and transport.

8.4 Incinerators are probably most useful in animal houses where they can be used for the immediate and safe disposal of infected animal bedding and other combustible waste. Except in areas like these where the risk of infection is high and the material is highly combustible, it is not advisable to install local departmental incinerators. Too often, they are small and unable to cope with the wet dressings and plastic waste they were not designed to incinerate. Larger incinerators which can dispose of these items are complex and require greater environmental control; they are not suitable for installation within the hospital building itself.

8.5 In the report of the working party referred to in paragraph 8.2[24] the recommendations for special types of waste state that,

> "Medical and contaminated or objectionable waste produced at hospitals need to be dealt with under special arrangements to ensure satisfactory disposal: where practicable, such wastes should be incinerated at each hospital. Incinerators inevitably result in some air pollution and their proliferation needs to be limited but we see no objection to incineration at a hospital of all its combustible waste provided the incinerator is of adequate capacity and design.
>
> At small hospitals scheduled for early closing, where there is no incinerator, or in emergencies, medical and infected waste may be bagged and transported to another hospital incinerator or alternatively, to a local authority incinerator or may be disposed of in a controlled tip subject to adequate safeguards."

Guidance on the type and size of incinerators for use in hospitals is given in British Standards 3316: 1970[12] and 3107: 1959.[14]

8.6 Two further quotations which are particularly pertinent to hospital waste problems are as follows:

"This appears to be the place to advise that a toxic waste should never be put into store merely because no-one can think what to do with it. This certainly has occurred, particularly with surplus laboratory chemicals which are easily set aside until someone decides what to do with them. Later they become nobody's business and they remain in store until the building must come down or be used for another purpose. By that time labels may be lost, no-one knows anything about the substances, and they are a source of embarrassment."[63]

"The Controlling Authority must arrange for the safe disposal of any radioactive waste that may arise.[23] The amount of radioactive waste should be kept to a minimum at all times."

8.7 In the same publication, Appendix 7 discusses fully the temporary preservation of radioactive animal carcasses until sufficient radioactive decay has taken place for disposal. Generally carcasses should be - if small, under 3.5 kgs - placed in heavy gauge polythene bags and treated as specified or if over 3.5 kgs, stored in plastic bins with well-fitting lids and treated as specified.

8.8 The difficulty of disposing of disposable plastic is increased because of the many varieties of plastic in use in hospitals. Some plastics ignite explosively and burn with an intense heat, these may easily ruin an incinerator lining; others are treated to resist heat and flame and may need waste paper to be mixed with them before they will burn freely. The type of plastic most dangerous to health are those which break down when burnt to liberate hydrochloric acid (as in the case of PVC) or hydrogen fluoride (as in the case of PTFE).

8.9 It is essential that all hospitals are aware of the potential of their incinerator. Although an increase in the effectiveness of design has produced incinerators which can deal with plastics without creating pollution in the atmosphere this may not be so for their particular model.

8.10 Mechanical grinders and shredders may be useful in some departments, these with the addition of water reduce bulk waste into fragments which can then be disposed via the sewerage system. Faecal specimen cartons of 'waxed cardboard' require waste disposal units with 150mm (6") cutters. All waste disposal units of this type whether free-standing or permanently connected to the drainage system must be provided with a trap. Disposable bedpan disposers work on this principle; it is important that care is taken over what is placed in these disposers, and that the waste pipes are of an adequate size. Waste compressors and paper balers are unlikely to be used at point-of-use, they will be installed at central disposal points.

8.11 The disposal of plaster also provides hospitals with waste disposal problems, Hospital Planning Note 6[81] states the disposal arrangements for plaster casts are not always satisfactory and it is recommended that new methods be tried.

8.12 In their plaster room Information Sheet[86] the Scottish Hospital Centre suggests that where an adequate central incinerator is available, plaster casts should be burned.

PART 9 CONVEYOR SYSTEMS

9.1 When deciding the number and type of lifts required for a particular hospital, it is important to remember that the capital cost of building them is high. Where at all possible lifts should be built in banks in order to reduce the structural work and the machine rooms required. Whether grouped together or not, simulation exercises of their use throughout the day may suggest that it is more suitable to build fewer general purpose lifts and allocate them for varying purposes at different times of the day, rather than provide lifts for specific purposes such as the movement of goods.

9.2 These and other considerations such as the seizing of lifts by portering staff (by jamming the lift gates with waste bags) so that they can remove waste vertically without having to wait for a free lift and therefore denying the use of the lift to other users must be carefully analysed when considering the installation of a system for waste removal at point-of-use.

9.3 Chutes are used in some hospitals for the removal of linen and general waste: they are obviously a one-way vertical system, and do not cater for supplying items at point-of-use, as do lifts or hoists. Each bag containing items for removal can be tied up and disposed of immediately it is full, thus saving the space normally required at point-of-use for the series of waste sacks which accumulate between collections. If the entry point to each chute is within the nurse working areas they will be used by nursing staff; this reduces the number of personnel entering nurse working areas. Under these circumstances it is also particularly advantageous not to store waste at point-of-use.

9.4 Because chutes can be used for more than one type of waste it is important that staff are made aware of the individual colour codes for each type. Failure to put the correct waste in the correct bags may lead to linen being incinerated and the laundry manager being faced with a bag of infected dressings or a bag of domestic waste. This may also happen if a ward or department is left without a sufficient supply of specific bags to cover a week-end or holiday period. Waste has to be put into a bag and if no other is available, it will go into a linen bag. Used needles from syringes and other sharp needles should always have special disposal arrangements, usually a cardboard container, particularly if waste is to be removed by chute; any sharp object will puncture a waste bag as it lands and lacerate the hands of the porter manning the exit point. Bags must be strong enough to take the shock as they land without bursting.

9.5 A policy decision on the use of chutes must be made at the earliest stage in planning any new buildings, they form part of the building structure, use up considerable space at the entry and exit points, and require careful installation both structurally and mechanically.

9.6 From a survey undertaken by Glasgow University[3], it may be seen that chutes have been used for many different hospital departments serving from one to nine floors. Chutes can be provided to serve individual departments, or they can be shared by several departments. If they are to be installed, careful consideration must be given to the entry point, if female staff are expected to tip disposal bags, which may weigh up to 18 kg (40 lbs), down the chute, the hatch must be at skirting level so that bags can be tipped straight in without lifting.

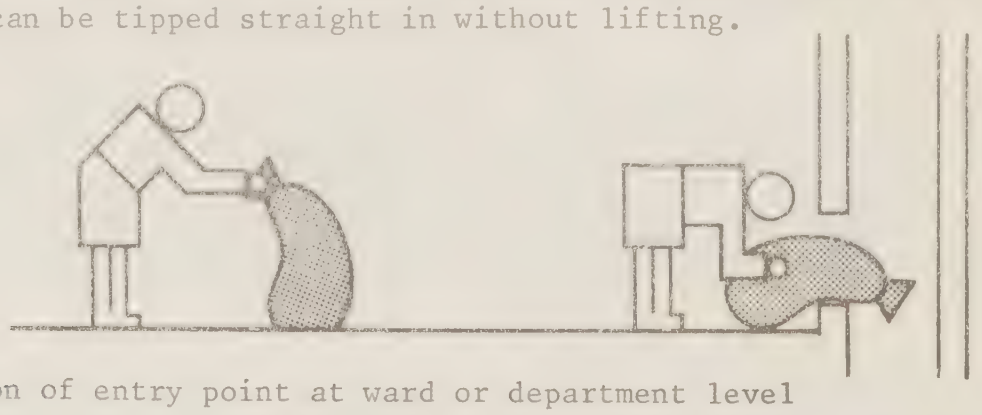


DIAGRAM 9.1 Position of entry point at ward or department level

Wherever the entry points are situated, care is needed in the design of the hatch entry so as to prevent mususe by unauthorised people, unwanted air flows and possible infection hazards. Much can be done to prevent the last two problems by providing exhaust fans at the top of the chute well above the highest entry point with air discharges away from any air inlet points or windows.[95] A further hazard, that of a nurse's or porter's hands and arms being injured by a waste bag being dropped from above whilst they are handling one down the shaft at an entry point may make it

necessary to ensure that no two hatches in one shaft are operable at one time. So far, this study has only dealt with simple mechanical handling systems which are manually operated. With the rising cost of wages, and the time that can be wasted awaiting deliveries, much work has been done particularly in the United States and Scandinavia in designing and installing automated supply systems in hospitals. These systems include paternosters and conveyors or a combination of the two, overhead rails, trolleys on magnetic lines in the floor, or tube systems; all are automated to varying degrees and communicate between points-of-use, or between points-of-use and central stores, and not all have been successful. If any of these systems are to be used, due consideration must be given to their use at the earliest planning stage. The design restraints of these installations are considerable and the effect upon the structural and mechanical services is even greater.

9.7 Throughout this report it has been emphasised that all the activities which are part of supply, storage and disposal must form part of a logical system. Mechanical handling aids are not necessarily the answer to supply problems. As Vandermade[18] states, a common misconception is that mechanisation is a universal solution to existing confusion! In a survey of automated systems by the British Columbia Hospital Insurance Service[18] it is stated that, "total automated materials handling systems for hospitals at this stage of their development cannot be justified on the savings expected in labour costs." In many of the hospitals surveyed, money was being saved on portering, but additional sums were being spent not only on the capital outlay and running costs of the automated equipment, but also on highly skilled mechanical engineers who were required to be on call at the times when the system was in use. It was for this reason that some hospitals were restricting the hours during which the automated system operated; as a result of this restricted use alternative systems of delivery had to be developed to cover the times that the automated system did not operate or when it broke down. In the Veterans Administration Hospital at Washington DC there was the added problem of a high turnover of staff and a continuous training programme was required to explain the automated system and the alternative system of delivery which had to be developed in the event of a breakdown in the system. From the problems which were noted in this survey it would appear that people are still an essential factor in any system. Automated systems in their present state of development are perhaps employing fewer people, but their wages as skilled mechanics are considerably higher than that of a porter.

9.8 J A McNab[49] states that, "What must not be overlooked, however, is that these requirements can be effectively met with a minimum of capital outlay by using wheels, people and elevators. The operating costs associated with this simple approach to materials handling are easily calculable and they form a basis for judging the cost-benefit values of augmenting the system". He continues, "every system needs back-up, either for reasons of safety or economy, and a certain amount of duplication is therefore unavoidable. It is wrong to buy hardware, however, without proper management analysis. Cost solutions are most likely to be found when problems are fully understood and quantified."

9.9 However one may consider fully automated systems at present, the time may come when the rise in labour costs and the technical improvement in these systems may make them worthwhile. It is very much a matter of deciding on a system for the economic life of the hospital and balancing this against manual labour cost and the reliability of the automated system selected; 20 years may be a suitable one for amortising these systems.

PART 10 SALVAGE AND OBSOLETE MATERIAL

10.1 Some areas within the hospital will be more involved than others in the storage of goods which can be returned for re-use or salvage. Salvage generally consists of clean waste paper and cartons and metal. Paper and cartons are normally sent to a central area within the hospital for baling: if this is not done, the amount of space which the salvage will take up can be anything up to ten times the volume of baled salvage. Metals of various kinds will be collected mainly by the works department, and swill will be collected by the central kitchens. Management Services (NHS) 1[25] recommends that all these items are sold by tender to approved merchants. Items for re-use will include those which can be re-cycled within the hospital itself, for example, bottles from the pharmacy department; these items can be collected at point-of-use and returned via the normal portering system. Other items will be returned to the manufacturers and again, most of these will be collected at point-of-use via the normal portering system to a central collection point; where a particular department does its own ordering and receiving, returnables will be held there for collection.

10.2 Silver which is recovered from x-ray film is an example of one of the few materials which are normally salvaged at source. Specialist firms provide the equipment for this operation; the latest methods of recovery by electrolysis recovers silver in an almost pure form, and leaves the hypo solution for further use as a fixer. Abstract of Efficiency Studies 158 includes a survey of the various methods used; it also describes a method of recovery used by one hospital group which enabled it to increase its percentage of r ecovery from 0.75% in 1962/3 to 4.79% in 1970/1 for every £1000 spent on x-ray film.

10.3 SHM 58/28[34] defines stores which are technically obsolete as those "which owing to changes of technique or user, there have been no demand for at least two years and for which no demand can be foreseen by the Board of Management concerned". It continues, "the procedure for declaring stores 'obsolete' should provide:-

a that such declaration is made only on the authority of a qualified officer or officers, charged with this duty;

b that detailed reasons are recorded why the stores should now be regarded as obsolete".

Other goods which can not be defined as technically obsolete come under the heading of "stores, which, though not obsolete, are surplus to immediate requirements"; these the memorandum says, "should only be disposed of either (a) if they are likely to deteriorate before they can be taken into use at the normal rate of consumption or (b) if they can be disposed of at not less than cost".

10.4 The amount of space taken up by salvage held in hospital and disposed regularly in the manner mentioned earlier is probably small in comparison to the space required for items which are obsolete and awaiting disposal. These are often large and may require storage space for some considerable time before they are disposed of. In the Management Services report on supplies this is seen as an additional function for the supplies department, the range of items listed includes obsolete or condemned furniture and equipment and obsolete stores. The report also suggests methods of disposal for various items as follows:-

vehicles	Government vehicle or local auction
furniture and equipment	local authority sales if possible. Alternatively by direct sale to staff. Old medical equipment may be useful to voluntary hospitals or homes or missionary hospitals
surplus stores	by sale to other hospitals or local authority or by sale by tender
occupational therapy products	by sale to other hospitals or to local authorities etc

10.5 Whatever method is chosen for the disposal of unwanted stores and equipment it is clearly the first duty of all those concerned in the selection and purchasing of equipment to ensure that their requirements are fulfilled by equipment which is likely to be used for as much of its economic life as can be reasonably foreseen; and that stores are ordered in quantities that are in line with the predicted estimates for their consumption.

A METHOD FOR MEASURING AND CATEGORISING PHARMACEUTICAL STORES AT POINT-OF-USE

From time to time the Scottish Hospital Centre has carried out studies involving specific nurse working rooms within different departments in hospitals. In order to ascertain the way in which these rooms are being used in existing situations, visits are made to hospitals and notes made on the way the rooms function. In some of the more detailed surveys, items stored within the rooms are also measured, identified and enumerated, so that these can be compared with other similar situations. This method of identifying and measuring items used was considered too elaborate and time-consuming for the type of study being undertaken, and the individual identification and measurement of items generated further difficulties. It was found that as the surveys were being carried out by multi-disciplinary staff, some of them were unable to differentiate between the brand or trade name and the generic name of an item. Further, the person entering information in the sequence in which it was given to her, discovered that some of the staff when measuring items gave the height first, some the width and some the length. Although this was soon rectified, and the sequence used standardised to the recommendations of BS 1192: 1969, it was still a tedious job, and some members of staff found it difficult to adjust to the new sequence of measures.

To overcome this difficulty, and to simplify the survey work to a degree that the depth of study merited, templates were designed which would enable pharmaceuticals to be measured easily and quickly to within a degree of accuracy acceptable for this purpose.

In order to design these templates, a survey was carried out of the containers used to store pharmaceutical items; these were measured for length, width and height, and the modal size of each range of items was selected as the appropriate size to be used for the templates.

Two templates were designed; these are illustrated in Annex 1. The first for bottles, jars and tall boxes and tins contains two sets of sizes, one shows the plan size and the other shows a scale of heights. The plan sizes were divided into three main categories, and were designated by colour, red was the smallest size, blue the middle size and green the largest size. Each of these was again divided into square and rectangular sub-sizes. The colours were used as a method of quick identification and for entering on to the collation sheet. The first template was designed for the measurement of all items from small tablet bottles to large tins of disinfectants. The second template was designed for measuring flat boxes and tins including ampoule boxes. Again the modal size of each of the range of items was selected as the appropriate size to be used for the templates. The rectangles were numbered from 1-4 in ascending order of size. The height of these boxes was restricted to 25mm (1").

To use the method during a survey items are placed on the relevant template, and the category into which they fit are entered on the summary sheet at Annex 2.

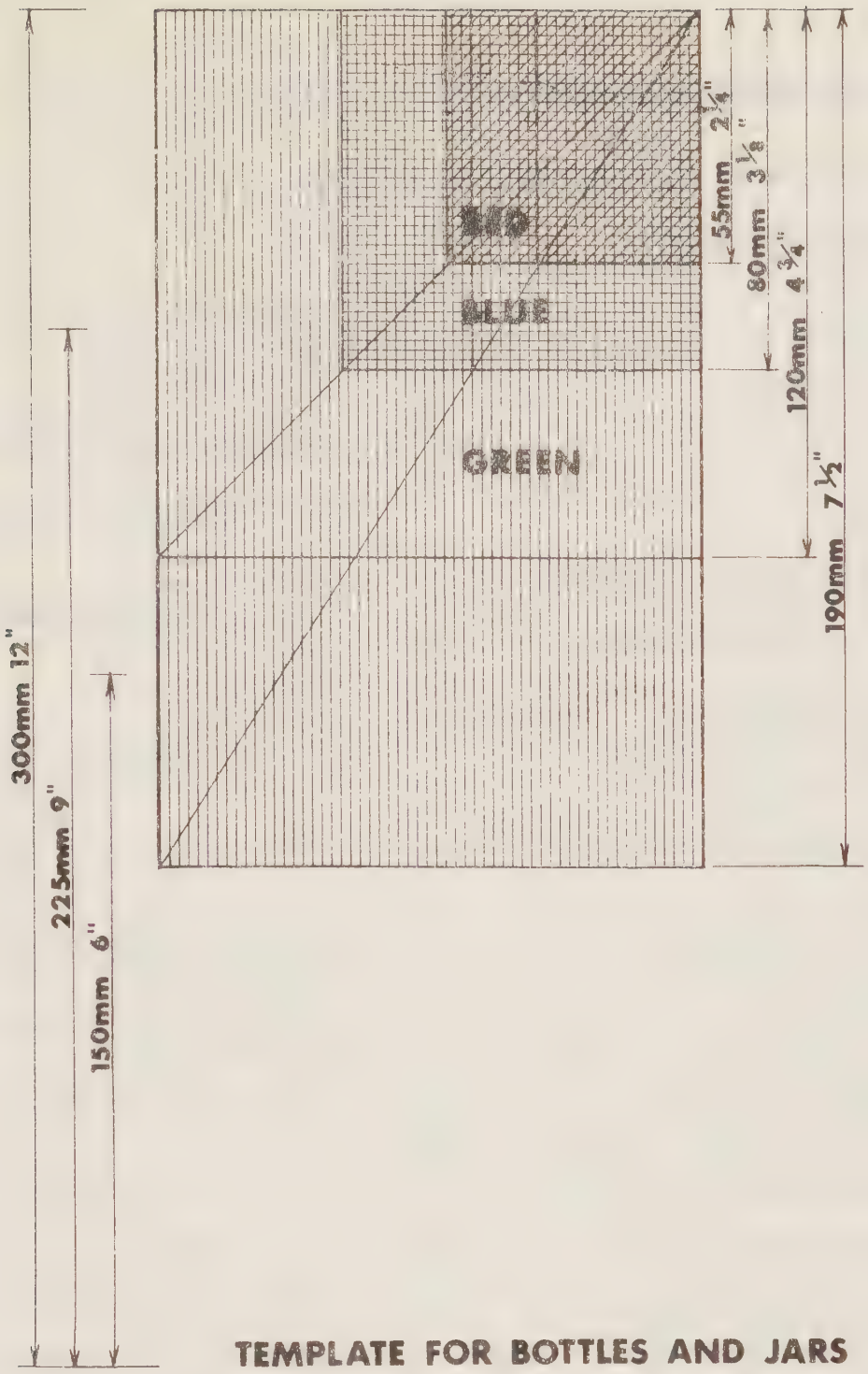
The advantage of the templates in ensuring that all users worked to a standard scale of measures was soon appreciated, observer differentials were obviated and the results could be written up in metric or imperial measures without extra calculations. Further, untrained staff under the supervision of one medically trained member of staff could enter the items used at point-of-use on to the collation sheet. On time alone, it was found that up to 50% was saved when the templates were used.

These templates can be easily made up out of cardboard or plastic, and the sizes given adjusted to suit new packaging sizes as these come on the market. Further templates designed from the same principles could be designed for other categories of item eg sterile nursing equipment and non-sterile nursing equipment.

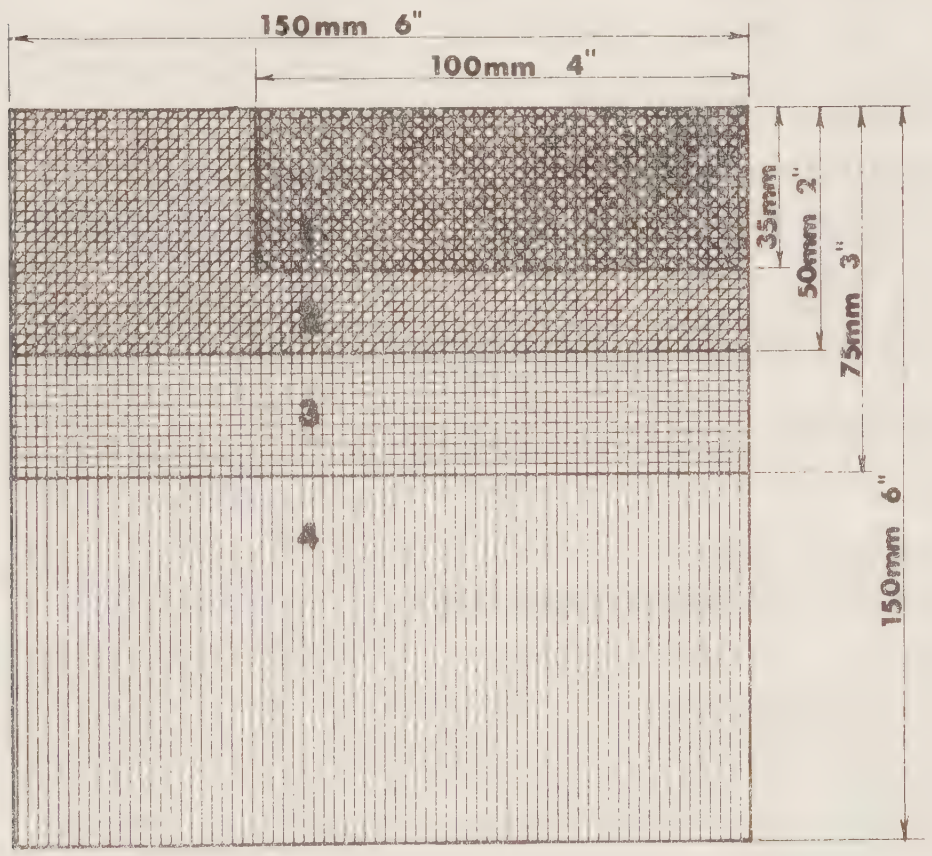
DATE	ENTERED BY	HOSPITAL

	BOTTLES AND JARS						FLAT CONTAINERS				COMMENTS
	RED		BLUE		GREEN						
	R	S	R	S	R	S	1	2	3	4	
DDA											
SCHEDULE IV											
ORAL											
RECTAL											
PARENTERAL											
TOPICAL APPLICATIONS											
DISINFECTANTS IRRIGATION											
INTRAVENOUS INFUSIONS											

ANNEX 1



TEMPLATE FOR BOTTLES AND JARS



TEMPLATE FOR FLAT CONTAINERS

MAXIMUM HEIGHT 25mm 1inch

ANNEX 2

APPENDIX II

CATEGORIES OF HOSPITAL STAFF

(Extracts from Scottish Health Statistics 1970)

Medical and Dental Staff

Consultants
SHMOs and SHDOs
Medical Assistants
Senior Registrars
Registrars
Senior House Officers
JHMOs and JHDOs
House Officers
General Practitioners
General Dental Surgeons

Nursing Staff

Administrative Nursing Staff
Qualified Tutorial Staff
Unqualified Tutorial Staff
Clinical Instructor
Departmental Ward Sister/
  Departmental Charge Nurse
Ward Sister/Charge Nurse
Staff Nurse
Senior Enrolled Nurse
Enrolled Nurse
Student Nurse
Pupil Nurse
Nursery Nurse
Nursing Auxiliary

Maternity Nursing Staff

Administrative Midwifery Staff
Qualified Tutorial Staff
Unqualified Tutorial Staff
Clinical Instructor
Departmental Midwifery Sisters
Midwifery Sisters
Staff Midwife
Student Midwife
Enrolled Nurses
Staff Nurse
Senior Enrolled Nurse
Nursery Nurse
Nursing Auxiliary

Mental Nursing Staff

Administrative Nursing Staff
Qualified Tutorial Staff
Unqualified Tutorial Staff
Clinical Instructor
Ward Sister/Charge Nurse
Deputy Ward Sister/Deputy Charge Nurse
Staff Nurse
Senior Enrolled Nurse
Enrolled Nurse
Student Nurse
Pupil Nurse
Nursing Assistant

Mental Deficiency Nursing Staff

Administrative Nursing Staff
Qualified Tutorial Staff
Unqualified Tutorial Staff
Clinical Instructor
Ward Sister/Charge Nurse
Deputy Ward Sister/Deputy Charge Nurse
Staff Nurse
Senior Enrolled Nurse
Enrolled Nurse
Student Nurse
Pupil Nurse
Nursing Assistant

Medical Auxiliaries

Chiropodists
Dietitians
Occupational Therapists
Opticians (Ophthalmic and/or Dispensing)
Orthoptists
Physiotherapists
Radiographers (Diagnostic)
Radiographers (Therapeutic)
Remedial Gymnasts
Speech Therapists
Diversional Therapists
Industrial Therapy Managers
Social Workers with Qual. of Inst. of M.S.Workers
Social Workers with Qual. of Ass. of P.S.Workers
Social Workers with Cert. of Council for Train. in Social Work
Social Workers with any other professional qual.
S.W.not prof. qual. but with Degree, Dipl. or Cert. in Social Sciences
Other Soc. Workers (unqual) and Soc. Work Assistants
Technicians (including students)
" Audiology
" Cardiological
" E.E.G.
" Dark Room
" Dental
" Medical Laboratory
" Medical Physics
" Post-Mortem Room
" Others
Dental Hygienists
Dental Surgery Assistants
Dental Auxiliaries
Supervisors in Schools in M.D.Hospitals
Assistant Supervisors in Schools in M.D. Hospitals

Dispensary

Pharmacists
Pharmacy Technicians
Other Staff

Scientific Staff

Biochemists
Physicists
Psychologists
Bacteriologists
Cytologists
Others

Hospital Operative Staff & Special Grades

Building Supervisors
Assistant Building Supervisors
Hospital Engineers
Assistant Engineers
Catering Officers
Assistant Catering Officers and Catering Supervisors
Domestic Superintendents
Assistant Domestic Superintendents and Senior Housekeepers
Storekeeper/Clerks
Laundry Managers
Assistant Laundry Managers
Farm Managers
Home Wardens
Assistant Home Wardens
Foresters
C.S.S.D. Superintendents
C.S.S.D. Deputy Superintendents

Domestic and Ancillary Staff

Kitchen Staff
Dining Room Staff
Laundry Staff
Ward Orderlies
Maids
Cleaners and other female domestics excluding those shown above
Stokers (including High Pressure Boilers)
Porters and Liftmen
Storekeepers and Storemen
Telephonists
Drivers
Farm Workers
Sewing Maids, Tailors, etc.
Instructors and Trainers (All Types)
Operating Theatre Attendants
Mortuary Attendants
Fire Safety Officers
Hairdressers and Hairdresser Attendants
Orthopaedic Workshop Staff and Surgical Shoemakers
Others

Total Maintenance Craftsmen and Tradesmen

Total Clerical Staff

All other staff not included above

APPENDIX III

SOME ITEMS TO BE REMOVED FROM A WARD

For destruction

Gauze
Cotton wool
Elastoplast
Strapping
Tubegauze
Plaster casts
Swab sticks
Sanitary towels
Colostomy bags
Ileostomy bags
Urine bags
Razor blades
Polythene containers
Gallipots
Milk bottle tops
Toothpaste tubes
Bedpans and urinals
Disposable gloves
Disposable sheets
Incontinence pads
Paper towels
Paper handkerchiefs
Drinking straws
Old flowers
Paper wrappings
Letters and postcards
Envelopes

Cigarette boxes
Match boxes
Cake boxes
Chocolate boxes
Ice cream cartons
Sputum cups
Cigarette ends
Spatulae and applicators
Disposable syringes
Disposable forceps
Refuse from handwork
Fruit skins
Stale cake
Biscuits
Egg shells
Nut shells
Tea leaves
Scrap food
Refuse from domestic cleaning
Patients' clothing
Newspapers
Lemonade bottles
Milk bottles
Broken glass - ampoules, bath salt bottles
- test tubes, chemical therm.
- medicine bottles, crockery
- ink bottles

For re-processing or return

Linen
Pharmaceuticals
CSSD packs
Food containers
Crockery
Cutlery
X-ray films

Case notes
Mail
Equipment
Oxygen tents
Balkan frames
Items for repair

DEVELOPING A MATERIALS HANDLING PROGRAM

Author: O Ernest Bangs, Associated Professor, School of Hotel Administration, Cornell University, Ithaca, NY

Whether developing a materials handling program for a new hospital or planning for the rehabilitation of an existing facility, there are certain factors that must be considered that will influence every facet of the program.

1 The basic characteristics of the items to be handled, such as their size, shape, weight, and state - solid or liquid - the volume of materials, and the frequency of handling have a definite influence on the selection of equipment or the method of handling decided upon.

2 Work stations or departments that are involved will determine the location of the areas where various items and materials should be handled and stored.

3 Transportation routes or paths of travel must be observed on floor plans and on profile drawings of the hospital building in order to get a complete picture of the transportation problems.

4 Environmental factors, such as sanitation, sound control, and temperature control must be considered.

5 People functions and equipment functions should be programmed and planned simultaneously in order to maintain economic control over both functions at the initial installation and over the years of operation. In this manner the probable operating costs of equipment, labour, and overheads can be calculated.

6 The function of storage space and the economical use and size of each storage area should be analyzed in regard to materials handling methods, space utilization, the size, weight, and shape of each package, carton, or container, and the location of central storage relative to receiving and the points of issue, supply, and materials dosage.

7 Waste disposal problems fall directly into the realm of materials management and handling facilities. Specially designed handling equipment and systems are now available to help hospitals economically overcome a large percentage of waste disposal problems.

8 As materials handling facilities and equipment become more complex, a well-trained and competent maintenance staff becomes an essential ingredient to a well-run hospital receiving and storage department.

9 A feasibility study should be conducted to evaluate all pertinent factors that may have a bearing upon the operational cost of materials handling equipment and facilities. Some of the pertinent factors to be considered are the initial cost of each piece of equipment, operating costs, labour, maintenance, replacement, depreciation, damage and repairs to equipment, and damage to materials and supplies.

MATERIAL MOVEMENT QUESTIONNAIRE

I <u>Basics</u>

Move What?	Materials
In What?	Container
Where?	Routing
How Often?	Frequency
How Far?	Distance
How Fast?	Speed
Upon What?	Environs - Roadways - Inside levels
	Floors ramps
	Aisles platforms
	- Openings - Doors - passages
By Whom?	Labour
With What?	Equipment

II Questions

1 What are the pathways for material movers? obstructed?

2 What is the grade of worker handling material?

3 Do processed materials or materials in process move more than once?

4 What is size or weight of loads?

5 What are the number of men engaged in handling materials in:

receiving
storage
processing
delivery

6 How often does each handling job occur? Are there any time or frequency constraints?

7 What is number of times each type of material is handled in each department?

8 What kinds of materials are handled?

9 What is the form in which each type is received and moved?

10 What are dimensions, weight and shape of each type, amount of each type (in weight or number of unit) handled each hour, day or week?

11 For each type of material - what is the beginning, end, length and nature of route (cross traffic, alternate routes, area and building covered)?

12 Are there materials with special handling characteristics? Contaminated?

13 How many accidents are attributed to materials handling? Any repeaters?

14 What are handling costs for each department?

15 Are there any bottlenecks or queues in the material handling field?

APPENDIX V

NATURAL METRIC EQUIVALENTS

cms		inches	metres		yards	m^2		y^2
2.5	1	0.4	0.9	1	1.1	.84	1	1.2
5.0	2	0.8	1.8	2	2.2	1.68	2	2.4
7.5	3	1.2	2.7	3	3.3	2.52	3	3.6
10.0	4	1.6	3.6	4	4.4	3.36	4	4.8
12.5	5	2.0	4.5	5	5.5	4.20	5	6.0
15.0	6	2.4	5.4	6	6.6	5.04	6	7.2
17.5	7	2.8	6.3	7	7.7	5.88	7	8.4
20.0	8	3.2	7.2	8	8.8	6.72	8	9.6
22.5	9	3.6	8.2	9	9.9	7.56	9	10.8
25.0	10	4.0	9.0	10	11.0	8.40	10	12.0
50.0	20	8.0	18.0	20	22.0	16.8	20	24
75.0	30	12.0	27.0	30	33.0	25.2	30	36
100.0	40	16.0	36.0	40	44.0	33.6	40	48
125.0	50	20.0	45.0	50	55.0	42.0	50	60
150.0	60	24.0	54.0	60	66.0	50.4	60	72
175.0	70	28.0	64.0	70	77.0	58.8	70	84
200.0	80	32.0	73.0	80	88.0	67.2	80	96
225.0	90	36.0	82.0	90	99.0	75.6	90	108
250.0	100	40.0	91.0	100	110.0	84.0	100	120

variations:
- 4cm in 250cms
+ 0.63ins in 40 ins

variations:
- 0.439m in 91m
+ 0.639 yds in 110 yds

variations:
+ .3874m in 100m
+ 0.4 yds in 100 yds

kilograms		Av.pound	litres		pints	litres		gallons
0.45	1	2.2	0.57	1	1.75	4.5	1	.22
0.90	2	4.4	1.14	2	3.50	9.0	2	.44
1.35	3	6.6	1.71	3	5.25	13.5	3	.66
1.80	4	8.8	2.28	4	7.00	18.0	4	.88
2.25	5	11.0	2.85	5	8.75	22.5	5	1.10
2.70	6	13.2	3.42	6	10.50	27.0	6	1.32
3.15	7	15.4	3.99	7	12.25	31.5	7	1.54
3.60	8	17.6	4.56	8	14.0	36.0	8	1.76
4.05	9	19.8	5.13	9	15.75	40.5	9	1.98
4.5	10	22.0	5.7	10	17.50	45.0	10	2.20
9.0	20	44.0	11.4	20	35.0	90.0	20	4.4
13.5	30	66.0	17.1	30	52.5	135.0	30	6.6
18.0	40	88.0	22.8	40	70.0	180.0	40	8.8
22.5	50	110.0	28.5	50	87.5	225.0	50	11.0
27.0	60	132.0	34.2	60	105.0	270.0	60	13.2
31.5	70	154.0	39.9	70	122.5	315.0	70	15.4
36.0	80	176.0	45.6	80	140.0	360.0	80	17.6
40.5	90	198.0	51.3	90	157.5	405.0	90	19.8
45.0	100	220.0	57.0	100	175.0	450.0	100	22.0

variations:
- .359 kgm in 45 kgs
- .462 lb in 220 pounds

variations:
+ .176 litres in 57 litres
- .980 pints in 175 pints

variations:
- 4.596 litres in 450 litres
+ .003 gals in 22.0 gals

APPENDIX VI

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